

Short Communication

Net photosynthesis of *Panax ginseng* on the different age in mountain area, Korea

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Accepted 8 November, 2010

Panax ginseng C. A. Meyer is an important pharmaceutical plant in North Eastern Asia. Five mountain forests, namely: Hongcheon, Sangju, Jinan, Poonggi and Andong were selected to compare net photosynthesis of *P. ginseng* in Korea. The net photosynthesis of 5 years old ginseng showed the highest values in all the forest areas. Obviously, net photosynthetic rates of forest ginseng grown in every five mountain forests decrease when the forest ginseng becomes old.

Key words: Age, forest ginseng, Korea, medicinal plants, net photosynthesis, *Panax ginseng*.

INTRODUCTION

Panax ginseng C. A. Meyer is an important pharmaceutical plant that has been widely used as a traditional medicine since ancient times. Its cultivation is difficult in the field because shade conditions must be maintained over the four to six years that are required before the roots can be harvested (Bae, 1978; Carlson, 1986).

In Korea, most *P. ginseng* is cultivated on farmland, under artificial shade. Those fields generally must be abandoned after harvest because of the high rate of nutrient depletion from the soil. The maximum cultivation lifespan is 6 years in the same soil. In contrast, forests can provide ideal environmental conditions for ginseng production because of their natural shading, sufficient organic matter, suitable relative humidity, and good interactions between trees and ginseng plants (Buell, 1984; Woo and Lee, 2002).

To increase rural community incomes, many farmers currently cultivate ginseng in the forest. The ginseng can survive more than 30 years in the forests. Sufficient physiological studies have been conducted for ginseng grown in the agriculture land with artificial shading. However, little physiological research has been conducted to determine environmental conditions for producing good forest ginseng crops in Korean forests

(Kim et al., 1995; Woo and Lee, 2002). The objective of this study was to compare net photosynthetic rates with different age classes grown in forests in Korea.

MATERIALS AND METHODS

Research sites and plant materials

Research sites were located in the region of the Republic of Korea (Figure 1). We selected five forest stands with very similar geographical properties to minimize environmental variations. Forest ginsengs were collected at the five different areas and three different age classes (5, 7 and 12 years old forest ginseng seedlings) in Korean.

Net photosynthesis (P_N)

The P_N was measured on a leaf on every individual. The P_N was measured with a broad-leaf cuvette from the Licor-6400 Portable Photosynthesis System (Licor Lincoln, NE, USA). The leaf was sealed and the CO₂ concentration was maintained at 400 $\mu\text{mol CO}_2$ levels. Five replications were done for each tree. Differences in the seasonal P_N were averaged for all measurements of each replicate, and the standard deviations were compared. Net photosynthesis was then calculated as:

$$A_n = \frac{U_e (C_e - C_c)}{100 s} - C_c E$$

Where, A_n = net photosynthesis ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$); U_e = mole flow rate of air entering the leaf chamber ($\mu\text{mol s}^{-1}$), C_e = mole fraction of

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Figure 1. Research sites of this study in Republic of Korea.

CO_2 in the chamber ($\mu\text{mol CO}_2 \text{ mol}^{-1}$ air); C_c = mole fraction of CO_2 entering the chamber ($\mu\text{mol CO}_2 \text{ mol}^{-1}$ air); s = leaf area (cm^2); and E = transpiration rate ($\text{mmol H}_2\text{O m}^{-2}\text{s}^{-1}$).

RESULTS AND DISCUSSION

Net photosynthesis (P_N)

The forest ginseng demonstrated a general decrease in P_N from 12 years old through 5 years old seedlings

(Figure 2). The P_N in 5 years old seedlings were higher than that in 7 or 12 years old seedlings on every 5 forest areas. Many other researchers showed similar results to this study (Woo et al., 2004; Seo et al., 2007). Many plants species generally showed high growth parameters such as P_N , transpiration rates and stomatal openness during the young stages in their life span (Kozlowski and Pallardy, 1997; Kimmins, 2004).

Regionally, the P_N of Jinan was highest values on every age classes. In contrast, the P_N of Sangju showed lowest

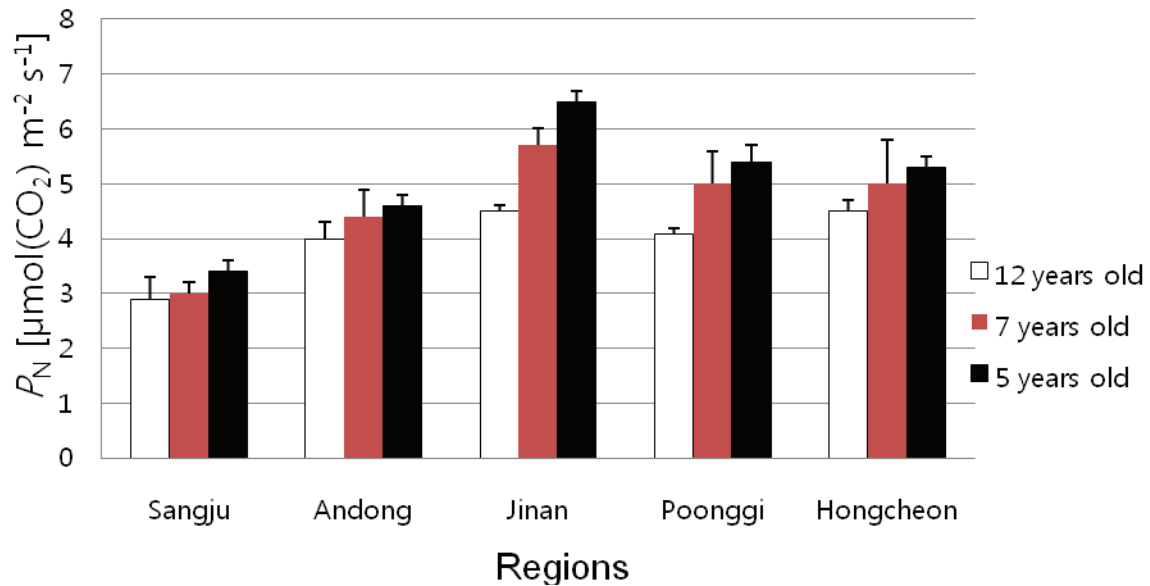


Figure 2. Comparison of net photosynthesis of 5 forest ginseng grown in forest areas. Bars indicate standard deviation ($n = 5$).

values among 5 forest areas in Korea.

ACKNOWLEDGEMENT

This study was carried out with the support of 'Forest Science and Technology Projects (Project No. S121010L100000)' provided by Korea Forest Service.

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