Journal of Medicinal Plants Research Vol. 5(22), pp. 5331-5336 16 October, 2011
Available online at http://www.academicjournals.org/JMPR
ISSN 1996-0875 ©2011 Academic Journals

Review

Forest cultivated ginseng in Korea: All cure medicinal plants

Hyoungmin Suh[1], Se Myung Seo [2], Su Young Woo[2]* and Dong-Sup Lee[3]

[1]Institute of Taerim, Sabeol, Sangju, Kyungbuk 742-962, Republic of Korea.
[2]Department of Environmental Horticulture, University of Seoul, Seoul, 130-743, Republic of Korea.
[3]Department of Forest Resources, Kyungbuk National University Sangju, 742-711, Republic of Korea.

Accepted 30 November, 2010

Forest cultivated ginseng, *Panax ginseng* C. A. Meyer, is an important pharmaceutical plant in North Eastern Asia. The Korean peninsula is the best place to grow ginseng because the plant has stringent requirements for growth, such as high precipitation during the summer and an appropriately low minimum winter temperature. Advantageously, forest cultivated ginseng requires little maintenance. Naturally shaded, well drained soil helps ginseng grow in forest habitats. It has been shown that net photosynthetic rates of forest ginseng plants grown in mountain forests are reduced as the plant ages.

Key words: Forest cultivated ginseng, medicinal plants, Korea, *Panax ginseng*.

INTRODUCTION

Panax ginseng is one of the important plant resources in Korea. It is a medicinal herb that naturally exists in only three regions; Korea, Manchuria, and the Littoral province of Siberia (Woo et al., 2004; Figure 1). Among them, the Korean peninsula is the best place to grow ginseng because the plant has stringent requirements for growth, such as high precipitation during the summer and an appropriately low minimum winter temperature. The value of Korean ginseng as an emergent medicine and tonic for long- life is known world-wide. *P. 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 shaded conditions must be maintained over the four to six years required before the roots can be harvested (Bae, 1978; Carlson, 1986). The Chin Dynasty of Ancient Chinese emperors pro-claimed that ginseng roots had many uses; namely as a stimulant for both physical and mental disorders, and for increasing fertility and libido. They called it the "never aging and death plant", and actively searched for this plant on the Korean peninsula. This plant has been recognized as having properties for strengthening the human body, and ultimately prolonging human life (Carlson, 1986).

*Corresponding author. E-mail: wsy@uos.ac.kr. Tel: (82) 2 2210 5634. Fax: (82) 2 2210 2838.

However, little physiological or ecological research has been conducted to determine the environmental conditions required for producing good ginseng crops in Korean forests (Kim et al., 1995; Woo and Lee, 2002). This scientific review includes information on forest ginseng, which is an upcoming, very important non-timber forest product in Korea. This review tries to provide the reader with a general idea of forest cultivated ginseng in Korea.

DIFFERENCES BETWEEN FOREST GINSENG AND AGRICULTURAL GINSENG

In ancient Korea, the royal family and high rank government officials alone owned wild ginseng; as it was so rare and there was not enough to satisfy the demands of medicinal practices. Korea's voracious demand for wild ginseng grew to an extent whereby the plant nearly became extinct as a result of overharvesting. Local communities started to cultivate wild ginseng in their fields, for the purpose of intensive agriculture.

Scientific classification taxonomy does not distinguish between wild ginseng and cultivated ginseng. The plant consists of leaves, stems, and roots (Figure 2). The root is widely used for the many purposes. The shape and size of wild ginseng and cultivated ginseng are very different (Figure 3); however, they use the same scientific name, *P. ginseng* C A Mayer.

Figure 1. Wild ginseng natural distribution map in Far Eastern Asia.

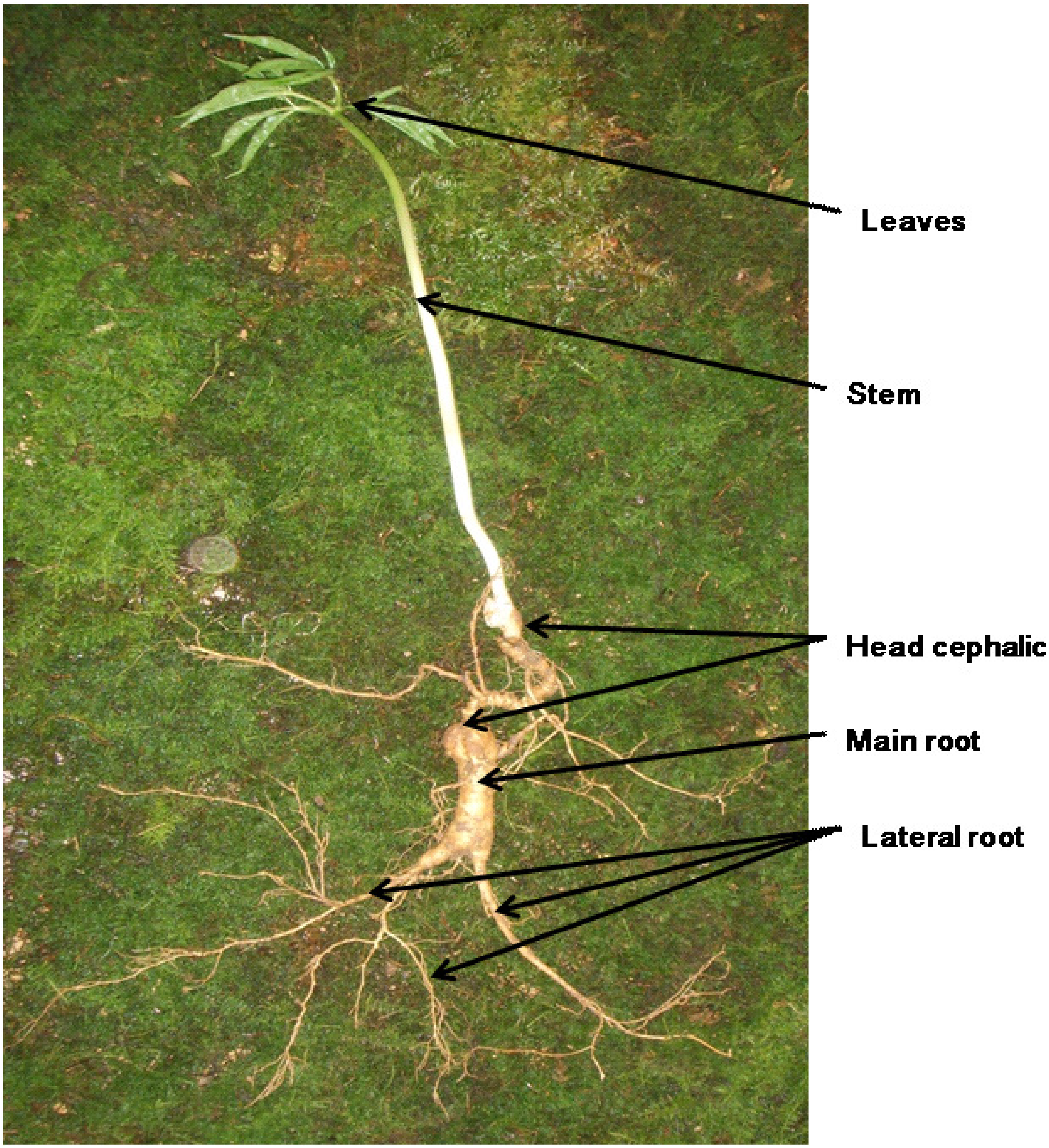

Figure 2. Shape and anatomical name of forest ginseng.

In North America, wild ginseng, which differs from *P. ginseng*, grows well especially in the well-drained, upland, deciduous hardwood forest. American ginseng (*Panax quinquefolius*) has forked–shaped roots that are bigger when compared to *P. ginseng*.

Wild ginseng is listed as an endangered or threatened plant species in many countries. Agriculturally cultivated ginseng, on the other hand, is not an endangered species. It is a very well known fact that wild ginseng, forest cultivated ginseng, and agriculturally cultivated ginseng have different shapes and pharmaceutical effects. However, their scientific names are the same; *P. ginseng*. Farmers produce, in mass, agriculturally cultivated ginseng on their farmland; however wild ginseng is rare in Korea. Commercially, forest cultivated ginseng can substitute the large demand for wild ginseng in Korea. Therefore, clear scientific classification of them should be established in near future.

a b

Figure 3. Forest cultivated (a) and agricultural cultivated ginseng (b) in Korea. Forest cultivated ginseng is much smaller than agricultural cultivated ginseng.

In Korea, most *P. ginseng* is cultivated on farmland under artificial shade. Those fields, generally, must be abandoned after the harvest because of the high rate of nutrient depletion from the soil. The maximum cultivation lifespan in the same soil is 6 years. In contrast, forests can provide ideal environmental conditions for ginseng production because of their natural shading, sufficient organic matter, suitable relative humidity, and beneficial 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 for more than 30 years in the forest habitats. Insufficient physiological studies have been conducted on ginseng grown in the forest, with natural vegetation.

GINSENOSIDES IN FOREST GINSENG

The beneficial properties of ginsenoside to human health are well known. Many reports (Bae et al., 2002; Shibada, 2001) have been published on the pharmacological and biological activities of ginsenocides Rx (x = b1, d, e, and g1). Ginsenosides are a class of steroid glycosides, and triterpene saponins, that are found exclusively in the plant genus *Panax.* Ginsenosides have been the target of research, as they are thought to be the active compounds behind the beneficial properties of ginseng. Ginsenoside content can vary widely depending on species, location of the plant, and the length of growing time before harvest (Dela et al., 2003).

Generally, the content per dry weight of ginsenosides, such as Rb1 and Re, have been shown to be higher in ginseng grown in forests than agriculturally cultivated ginseng. In Korea, the Rb1 and Re contents, of *P. ginseng* grown in forest habitats, exhibit various regional trends. It is very difficult to know the forest area or topography that stimulates the highest ginsenoside contents at the time of harvest (Woo et al., 2004).

CULTIVATION ENVIROMENTS IN KOREA

Advantageously, forest cultivated ginseng requires little maintenance. A naturally shaded environment and well drained soil are important factors helping ginseng grow in the forest. Minimal use of pesticides may be necessary if pests threaten forest ginseng.

Different forest tree compositions provide various physiological traits, growth rates, and saponin contents (Woo and Lee, 2002). The height and dry weight of forest ginseng grown in oak stands were greater than those of pine or mixed stands. The photosynthetic rates of ginseng plants grown in oak stands were higher than those grown in pine or mixed forest habitats (Figure 4). Maximum photosynthetic rate of the ginseng has been observed at a light intensity of 200 μmol m^{-2} s^{-1}, in an oak forest habitat (Woo et al., 2004).

In Korea, forest ginseng plants have demonstrated a general decrease in P_N as they age (Personal communication). The P_N of 5 year-old seedlings were higher than in 7 or 12 year-old seedlings, in all 5 forest areas that were tested. Many other researchers have found similar results to this study (Woo et al., 2004; Seo et al., 2007). Many plants species exhibit high growth parameters such as P_N, transpiration rates and stomatal openness during the young stages of their life span (Kozlowski and Pallardy, 1997; Kimmins, 2004).

Regionally, the P_N of ginseng grown in the Southern part of South Korea exhibited the highest values in every age classes. In contrast, the P_N of plants grown in the middle part of South Korea exhibited the lowest values,

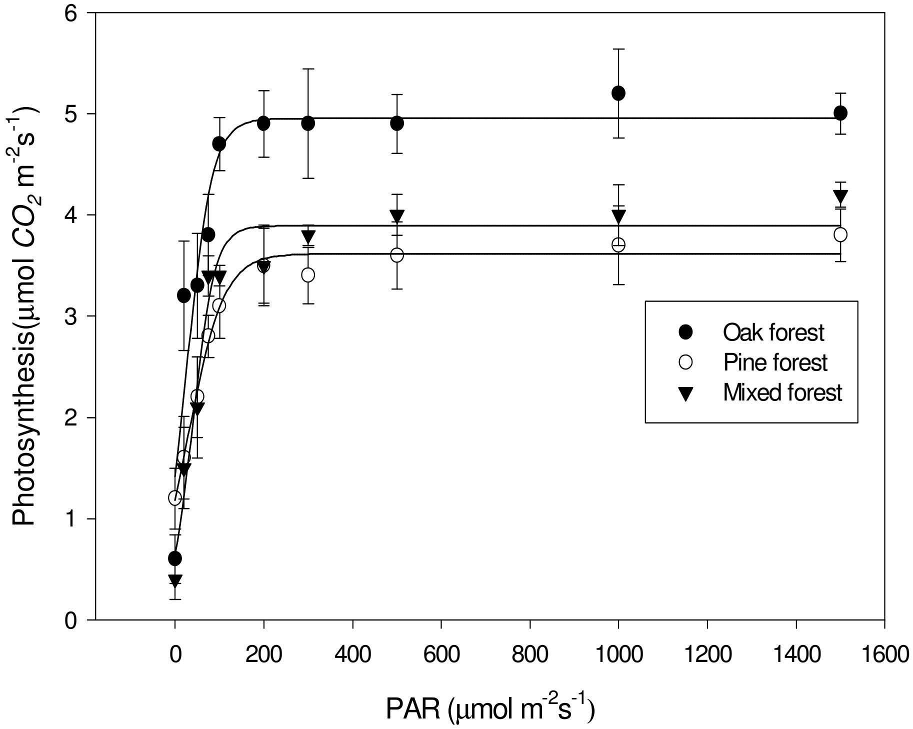

Figure 4. Light response curves to photosynthesis of *Panax ginseng* seedlings (forest cultivated ginseng) in oak, pine and mixed stands (Measurements were taken at 25°C chamber temperature, 65% relative humidity and 360 ppm CO_2 concentration, Li-Cor 6400), (Woo et al., 2004).

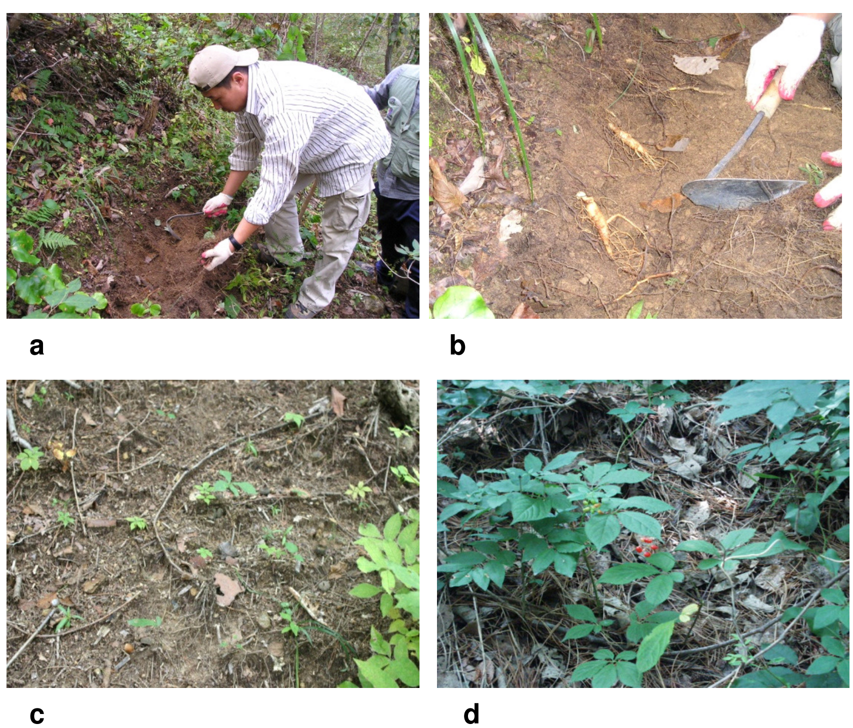

Figure 5. Transplanting process in the forest from nursery in November, (a) remove organic matter on the forest floor and dig the ditch for 10 to 15 cm depth, (b) put the ginseng seedlings carried from nursery and cover the soil, (c) 1 year later, (d) 4 years later after transplanted form nursery.

among the 5 forest areas tested in Korea (Seo et al., 2007). Forest ginseng grows wild through all of the country; however, eastern parts of South Korea are well known places to cultivate the plant. Wild ginseng is a very expensive venture that requires the usage of valuable land. Forest ginseng is an alternative to wild ginseng exploitation. Forest ginseng refers specifically to the use of a natural forest canopy for shade. Cultural techniques vary between the many forest conditions, and approximate to the practices used to culture ginseng under artificial shade.

Little is known of the soil requirements for forest ginseng. It grows best in well-drained, porous soils, with a rich topsoil and humus generated from hardwood and other forest litter. Many case studies have observed that adequate Ca is equally a critical soil factor as pH for successful ginseng harvest (USDA, 2010).

In cultivating forest ginseng, ripe seeds are gathered in the autumn; ginseng plants begin to produce fruit after the third or fourth year. The collected seeds are placed by layers in barrels of slightly sandy or forest soil, for a 1 year stratification process. In the next autumn, the seeds are sown at a 5 to 10 cm soil depth, after the forest organic matter has been removed. The soil has to be recovered as soon as seeds are sown. It takes approximately 7 to 8 growing seasons to produce a marketable root from time of seed sowing.

Forest ginseng seedlings can be transplanted to the forest floor when the seedlings are about to grow in the forest. Farmers establish a bed, and ginseng seeds are sown on the bed in the spring to obtain seedlings. One or two years later, the seedlings are transplanted to the forest in November (Figure 5). Five or six years later, farmers can harvest forest ginseng. The transplanted forest cultivated ginseng plants are generally bigger than those that were directly sown, as seedlings, in the forest.

ACKNOWLEDGEMENT

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

REFERENCES

Bae EA, Park SY, Kim DH (2002). Constitutive b-glucosides hydrolyzing ginsenoside Rb1 and Rb2 from human intestinal bacteria. Biol. Pharma. Bull., 23: 1481-1485.

Bae HW (1978). Korean Ginseng. Samwha Printing Co. Seoul, Korea.

Buell PD (1984). Theory and practice of traditional Chinese medicine. In Chinese medicine on the golden mountain- An interpretive guide-Schwarz HG (ed). Wing Luke Memorial Museum, Seattle, USA. pp. 25-50.

Carlson AW (1986). Ginseng: America's botanical drug connection to the orient. Econ. Bot., 40(2): 233-249.

Dela G, Or E, Ovadia R, Nissim-Levi A, Weiss D, Oren-Shamir M (2003). Changes in anthocyanin concentration and composition in 'Jaguar' rose flowers due to transient high-temperature condition. Plant Sci., 164: 333-340.

http://www.sfp.forprod.vt.edu/factsheets/ginseng.pdf

Kim DC, Chang SM, Choi J (1995). Effects of the chemical properties of field soils on the contents of sugars and saponin in ginseng roots. Agric. Chem. Biotechnol., 38: 72-77.

Kim SY, Kim SH, Shin KS, Lee H (2010). Physiological Activities of Ginsenoside-rich Fraction Isolated from Panax ginseng Leaves. Food Sci. Biotechnol., 19(3): 803-808.

Kim YS, Han JY, Lim S, Choi YE (2009). Ginseng metabolic engineering: Regulation of genes related to ginsenoside biosynthesis. J. Med. Plant Res., 3(13): 1270-1276.

Kimmins JP (2004). Forest Ecology (3rd Ed.), Macmillan Publishing Company, New York, USA.

Kozlowski TT, Pallardy SG (1997). Physiology of Woody Plants (2nd Ed.), Academic Press, London, UK.

Park JD, Rhee DK, Lee YH (2005). Biological activities and chemistry of saponins from *Panax ginseng* C. A. Meyer. Phyto. Rev., 4: 159–175.

Seo SM, Woo SY, Lee DS (2007). A study on the photosynthetic rates of *Panax ginseng* in the different age and provinces. J. Kor. For. Soc., 96(3): 357-361.

Shibada S (2001). Chemistry and cancer preventing activities of Ginseng saponins and some related triterpenoid compounds. J. Kor. Med. Sci., 16: 28-37

USDA (2010). Non-timber forest product. Ginseng Fact sheet No. 7.

Woo SY, Lee DS (2002). A study on the growth and environments of *Panax ginseng* in the different dorest dtands (I). Kor. J. Agric. For. Meteorol., 4(2): 65-71.

Woo SY, Lee DS, Kim PG (2004). Growth and eco-physiological characteristics of *Panax ginseng* grown under three different forest types. .J Plant Biol., 47(3): 230-235.