

AMERICAN GINSENG is a perennial plant indigenous to North America, mostly the central and eastern regions of Canada and the United States. Its preferred natural habitat is a moderate to rich, well-drained soil shaded by hardwood trees; shade of about one-third normal sunlight is a very important component usually provided by wood lath or black polypropylene screening. A pH optimum is about 5.5, and required moisture in the amount of 100 cm annually is usually supplied by rain. Mulching is another important ingredient in natural and cultivated production, as it acts as a buffer for moisture and temperature fluctuations. The cultivated crop is commonly grown on raised beds.

Ginseng roots from native non-cultivated woodlot or forest populations are collected by gatherers, much like is done with wild mushrooms. Traditional gathering from indigenous native growth has become limited, and American ginseng may become an endangered species. Short supply and high demand has encouraged shaded cultivation, which was started during the late 1800's. However, ginseng root as a cultivated crop is not as highly regarded as wild ginseng by its consumers.

P. quinquefolium is American ginseng, whereas *P. ginseng*, known as Oriental ginseng, is native to wooded areas of northeastern Asia, where it has been cultivated since 2,000BC. Korea and China are the major producers of Oriental ginseng, and Wisconsin is the primary United States producer of American ginseng, although Canadian production has increased substantially. Average dried root yields are about two tons per hectare, with a U.S. value of about \$100 per kilo. The estimated cost of shade-cultivated crop establishment in North America is about \$6,000 per hectare.

Ginseng growers, much like truffle producers, are secretive about their activities, especially regarding access to rapidly-disappearing non-cultivated populations. Relatively few producers and limited supplies tend to keep prices high. Ginseng's major attraction is its putative therapeutic compounds; its curative powers are highly regarded. These are most appreciated in Japan, China and Korea, although there are patrons in other countries. Its cure-all pharmacological properties are often exceeded by claims of its aphrodisiac benefits. Ginseng use has been credited with helping to reduce short-term memory loss. The saponin glucosides (ginsenosides) are the recognized active ingredients, and saponin content is the major component determining the product's market value.

Ginseng grows very slowly; reproductive maturity requires five to eight years, sometimes more. Even after five years of growth, the spindle-shaped fleshy taproot (25 to 30% dry matter) may be only 10 cm long and two to three cm thick. Root weight increases with continued growth and is affected by plant spacing. Growth beyond five years will usually show branching. Root branching, although a cosmetic factor, has a strong effect on perceived value in that the more the root and lateral branches resemble the human figure, the greater the value. Some growers intentionally promote root branching.

Plants are deciduous, and foliage growth is slow and sparse. The best overall growth occurs at 18 to 20°C; root growth is maximum at 15 to 18°C. No leaf growth occurs at less than 5°C, and temperatures above 30°C suppress growth. Plants are relatively temperature-hardy, and well-mulched plants tolerate temperatures as low as -10°C.

The rhizome grows upright or horizontally at the base of the stem; upright growth is most common with the cultivated crop. The new terminal bud is initiated on the rhizome during mid-summer and enlarges during the rest of the active-growth period. It is elongated in the spring with the occurrence of warm temperatures. Annual abscission scars appear on the rhizome.

The solitary aerial stem produces a whorl of compound leaves at its apex, each having a petiole to which are attached three to five palmate-like leaflets. Only older plants produce a whorl of foliage with four or five leaves, and those with five leaflets do not appear until the fourth or fifth year, sometimes later. The limited leaf growth partly explains the tediously slow plant and root development. Native plant growth is much slower than those of cultivate plants, which by the fourth or fifth year may achieve a height of 50 to 60 cm.

Flowering may begin towards the end of the third or fourth season's growth. Flowers are polygamous (both unisexual and bisexual flowers on the same inflorescence). From 15 to 50 small greenish-white flowers (mostly self-pollinated) form in a cluster on a hemispheric tall umbel. The fruit is a pea-size berry that becomes bright red when mature and usually contains two small, 5mm, flat, wrinkled seeds. Growers remove flowers when the production emphasis is root growth; seed removal has been shown to enhance root growth yields about 30%.

However, a portion of production is allowed to produce seed, which are used for propagation directly, or to produce nursery-grown transplants. Plants usually do not produce seed until the third year, and preferred seed is from plants older than four years. A four-year-old plant is expected to provide from 30 to 40 berries.

Harvested seed is washed after removal from the fruit, but for seed to remain viable, it cannot be allowed to dry. Accordingly, seeds are stored at a low temperature in slightly damp sand. Germination is very slow, and seeds should be stratified; and because of seed embryo immaturity, allowed to continue maturation. Harvest seed normally will not germinate for as long as 20 months, and before sowing should be pre-germinated. Stratified seed for propagation commonly sells for \$250 to \$350 per kilo.

Native stand populations are variable and usually at low densities, whereas cultivated plantings might have 200 thousand plants per hectare. Dried root yields from cultivated fields are about two tons per hectare. Harvest involves digging out roots, usually with hand tools after leaf fall. After cleaning roots free of soil, they receive post-harvest curing

by drying. Ginseng is not used until it has been dried. The artificial drying treatment occurs at a temperature of 32 to 33°C for about two weeks. Excessive temperature, duration, or very rapid drying is avoided; natural drying is preferred. Generally, moderate (25°C) heat and high air movement is used for the initial stage of drying, and then air movement is slowed and the temperature is increased to 32°C. Dried roots are aromatic, have a licorice-like taste, and are used in a powdered form in numerous preparations.

Ginseng is susceptible to diseases that include damping off, anthracnose, verticillium, and root rots. Insect pests are leafhoppers, aphids, and cutworms. Additional pests are rootknot nematode, snails, slugs, mice, and weeds.