

Hydroponic and Organically Grown American Ginseng

Thomas S. C. Li

Agriculture and Agri-Food Canada, Pacific Agri-Food Research Center, 4200 Hwy. 97, Box 5000, Summerland, BC V0H 1Z0
(Received June 24, 2005; Accepted November 30, 2005)

Abstract : A new cultural practice for commercial production of American ginseng by organically grown in a shaded greenhouse under controlled environment conditions has been developed. This new procedure will shorten the dormant period and reduce the cultivation period from 4 years in conventionally grown ginseng to 2 years.

Key words : Hydroponics, American ginseng, Organic, Ginsenosides.

Introduction

American ginseng (*Panax quinquefolium* L.) is a slow-growing herbaceous perennial plant indigenous to Quebec, Canada¹. It is now cultivated under a woven polypropylene cloth in Ontario and British Columbia for its highly valued root. Canada is currently one of the major American ginseng producers in the world, and its ginseng production exceeded 2,000 tones in 2004².

Conventionally in North America, American ginseng takes four years of cultivation before harvest. Ginseng farmers have many hurdles to overcome which are soil-borne diseases which cause damping-off and root rot, unfavourable weather conditions such as excess precipitation, temperature fluctuations in early spring and during the growing season, and severe winter conditions. Availability of suitable agricultural land and extensive labour requirements during cultivation such as setting up cultural structures, seeding, weeding, disease and pest control, add to the list of concerns for ginseng growers.

The demand for organically grown agricultural products, especially medicinal herbs, is increasing around the world. Nowadays, consumers are well aware of the potential hazards of chemicals to their health, and are demanding residue free or organic products.

Hydroponic or soil-less culture methods have been developed for many decades³. This has become a popular cultural method around the world, especially for vegetable crops⁴. Increasing interest in hydroponic ginseng is evi-

dent by considerable number of inquiries in the internet⁵; there is very little information available in the literature. A report on improving selenium content in Korean ginseng by using a hydroponic system has been published⁶. There are many benefits in hydroponic culture of ginseng, such as without the threat of soil-born pathogens that cause root diseases and the need for hazardous chemical applications which accumulate residues in ginseng roots. It would be a major break through if this technology could be used in ginseng.

The objective of this study was to develop a new cultural practice for commercial production of American ginseng by organically growing it under controlled environment conditions in a shaded greenhouse. This new procedure will shorten the dormant period and reduce the cultivation period from 4 years in conventionally grown ginseng to 2 years.

Materials and Methods

Mature ginseng berries were collected from 4-yr-old plants, seeds were extracted and washed. Clean seeds were mixed with sand and stratified indoors in a controlled environment subjected to 3 months of warm 15°C and 4 months of cold 2°C stratification periods⁷. Seeds were ready for germination when the length of the embryo reached around 6 mm⁷. Root trainers (Spencer Industries Ltd., Alberta, Canada) were filled 2.5cm deep with 0.5-1.0cm diameter gravel covered with 20cm of cultural media mixed with 30% perlite, 50% peat moss and 20% forestry sand (fig. 1). Three to four seeds per root trainers were seeded by 1cm deep.

[#] To whom correspondence should be addressed.
(Tel) 250-494-6375; (Fax) 250-494-0755
(E-mail) lit@agr.gc.ca



Fig. 1. Root trainers.



Fig. 3. Hydroponic ginseng plants.

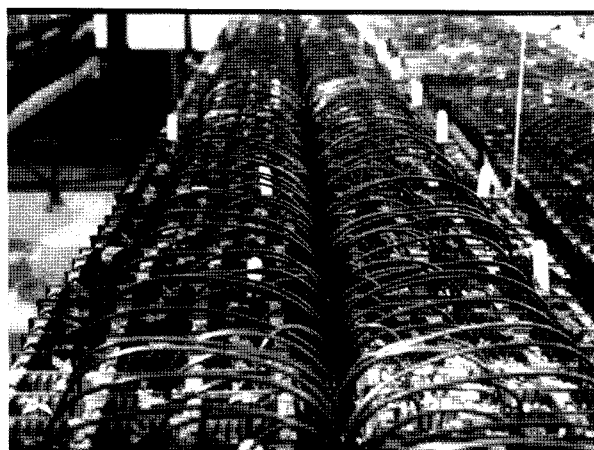


Fig. 2. Irrigation system.

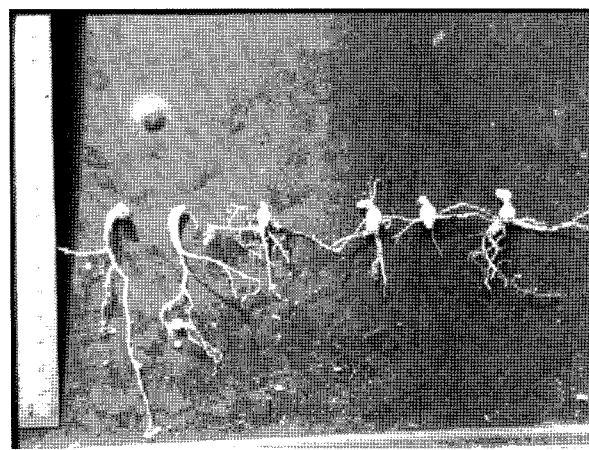


Fig. 4. Shape of ginseng roots after 2 growing seasons. Two on the left are field grown roots. Four on the right are hydroponically grown roots.

Seeded root trainers were moved to a shaded (78%) greenhouse with day and night temperatures of 20 - 22°C. Seedlings were fertigated (fig. 2) with an automatic irrigation system from a tank (40 L capacity) filled with 0.5 g/L Mermaid's Organic Fish Fertilizer (12 - 0.25 - 1, N-P-K) (Integrated Fertility Management, Wenatchee, WA 98801) and 0.5 g/L Acadian sea weed extract (1 - 1 - 2, N - P - K) (Gaia Resources, Grand Forks, BC, Canada). Fertigation was applied weekly for 3 weeks and water only on the 4th week to leach out the possible fertilizer residue accumulation. The seedlings were irrigated with water between fertigation periods, if there was a need for moisture.

Seedlings (fig. 3) were grown in the greenhouse for 20 weeks before being moved to cold storage (2-4°C) for a 14-week dormant period. These seedlings were considered one year old after the dormant period. This procedure was repeated in the greenhouse for the second season.

Hydroponically grown ginseng roots were harvested after two growing seasons. Two groups of 30 roots each were randomly collected, fresh weights were measured and recorded immediately after washing and drying with paper towels. All samples were freeze dried at -65°C and ground in a Wiley mill to pass through a 1-mm screen and stored in plastic bags at -35°C until analyzed. Seven major ginsenosides (Rb₁, Rb₂, Rc, Rd, Re, and Rg₁) were extracted using reverse-phase high-performance liquid chromatography (HPLC). Each quantified using standard curves prepared by injecting measured volumes of standard solutions of authentic ginsenosides (Carl Roth GMBH, Karlsruhe, Germany)⁸. Data from field grown 2-year-old roots⁹ were used for comparison (Table 1).

Possible insect and fungal infection on ginseng plants were observed every other day.

Table 1. Fresh weight and ginsenoside contents of 2-yr-old hydroponic and field grown 2-yr-old American ginseng roots.

Sample	Fw. (g)	Average ginsenoside contents (mg/g)						Total
		Rb ₁	Rb ₂	Rc	Rd	Re	Rg ₁	
1	1.96 b	4 a *	0.3 a	2.1 a	1.4 a	7.4 a	0.7 a	15.9 a
2	1.88 b	2.7 b	0.3 a	1.6 b	1.1 a	7.5 a	0.8 a	14.0 a
3	3.97 a	5.0 a	0.1 a	0.8 c	1.5 a	7.6 a	0.8 a	15.8 a

Samples 1 and 2, hydroponic grown ginseng roots; sample 3, field grown ginseng roots.

Fw - fresh weight

*Means in each column followed by the same letter are not significantly different ($p=0.05$) according to Duncan's new multiple range test.

Results and Discussion

A hydroponic system for growing organic ginseng under a controlled environment was established and proved to be feasible when compared to conventionally field grown ginseng. As shown in Table 1, The fresh weight of hydroponically grown roots is much smaller than field grown roots. However, the favorable pearl shape of the roots is the major attraction for the consumer (fig. 4) (Personal communication with ginseng retailers). Ginsenoside contents from both hydroponically and field grown 2-year-old roots are comparable (Table 1).

An outbreak of powdery mildew in the greenhouse was discovered on the leaves during the experiment. A fine dust of sulphur (92%, microscopic wet-able sulphur, N.M. Bartlett Inc., Beamsville, Ontario) was applied by using a Arimitsu 'Whirlybird' spreader to the surface of the infected leaves. The treatment was applied again two weeks later to all the ginseng plants to prevent further outbreaks of powdery mildew.

During the entire project, there were thrips breakouts in the greenhouse. Thrips occurred randomly throughout the growing season, but more often in the hotter weather months. To eliminate the thrips infection, a predaceous mite, natural predator, *Amblyseius cucumeris*, (Westgro, Delta, B.C.) were applied to the leaves of all ginseng plants in the greenhouse. The thrips were eliminated within a few days, but a few fine yellow spots remained on the ginseng leaves due to the thrips infestation.

Based on the results of this project, it can be concluded that it is feasible to grow ginseng organically with a hydroponic system under controlled environment. The size of the root produced under this new technique is smaller than conventionally grown roots, however, the pearl shape roots have marketing advantage, because oriental consumers are interested and willing to pay a high price for so called 'pearl ginseng roots'. Hydroponically

grown ginseng is a totally new and unique category that is superior to field grown, wild, and semi-wild ginseng.

Further studies are needed to reduce greenhouse operating costs and to maximize the usage of greenhouse space. Public education and awareness are key factors for the success of this new concept, since hydroponic ginseng is totally chemical free, organically grown and with good ginsenoside contents compared to conventionally grown ginseng of the same age.

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