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Studies on Cultivation of *Panax ginseng* in Thailand: I. A Theoretical Possibility of Ginseng Cultivation in the Environmental Different Conitions

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Synopsis

Developmental pattern of ginseng was discussed correlating with the seasonal change of climatic conditions in Nagano Prefecture, Japan and at highland experimental station in northern Thailand. According to the environmental requirements for the optimum growth, ginseng could theoretically be grown in northern Thailand by developing some technologies which include the controlling photoperiod, low temperature treatments, application of suitable growth regulators and reduction of light injury

1. Introduction

Ginseng (*Panax ginseng*) or the so called "Korean ginseng" is one of the most well known medicinal plants for its tonic effects and antifatigue medicine. The dried roots of ginseng plant are consumed worldwide and utilized as different types of product: Red ginseng (Kojin), White ginseng (Hakujin), Boiled ginseng (Yudoshi), Normal dried ginseng (Namaboshi). Product forms are differently prepared in a fragment, powder, expract, beverage or even in tablet[1].

Originated in cold mountainous areas of north-eastern China to Russia and Korea, ginseng is a typical temperate medicinal plant and requires a relatively cold temperature for the optimum growth and development. The plants also require an intensive crop management to achieve the best yield and high quality product. Due to its higher price and greater demand for world market, ginseng is one of the most interesting crops to be cultivated in many agricultural areas including the tropical countries.

Under the cooperative program for scientific exchange and research between Kinki University, Japan and Chiang Mai University, Thailand. An important goal is to introduce some medicinal plants with high commercial value to the farmers in the opium cultivating area in northern Thailand. For this aim ginseng has been introduced and emphaized due to its comparable price to opium. Study to develop the proper cultivation technology for ginseng under subtropical climate of highland areas in northern Thailand have been started since the year 1990. In this paper and in the coming ones, the experimental results willbe respectively discussed.

2. Consumption of ginseng in Thailand

It is believed that ginseng was firstly introduced to Thailand by the immigrated Chinese people some 100 years ago. At the first stage, ginseng was used classically only in the Chinese folk medicine, especially for the old people or the patients. In the present, ginseng is also favorite among the young executive people for its antistress and antifatigue effects.

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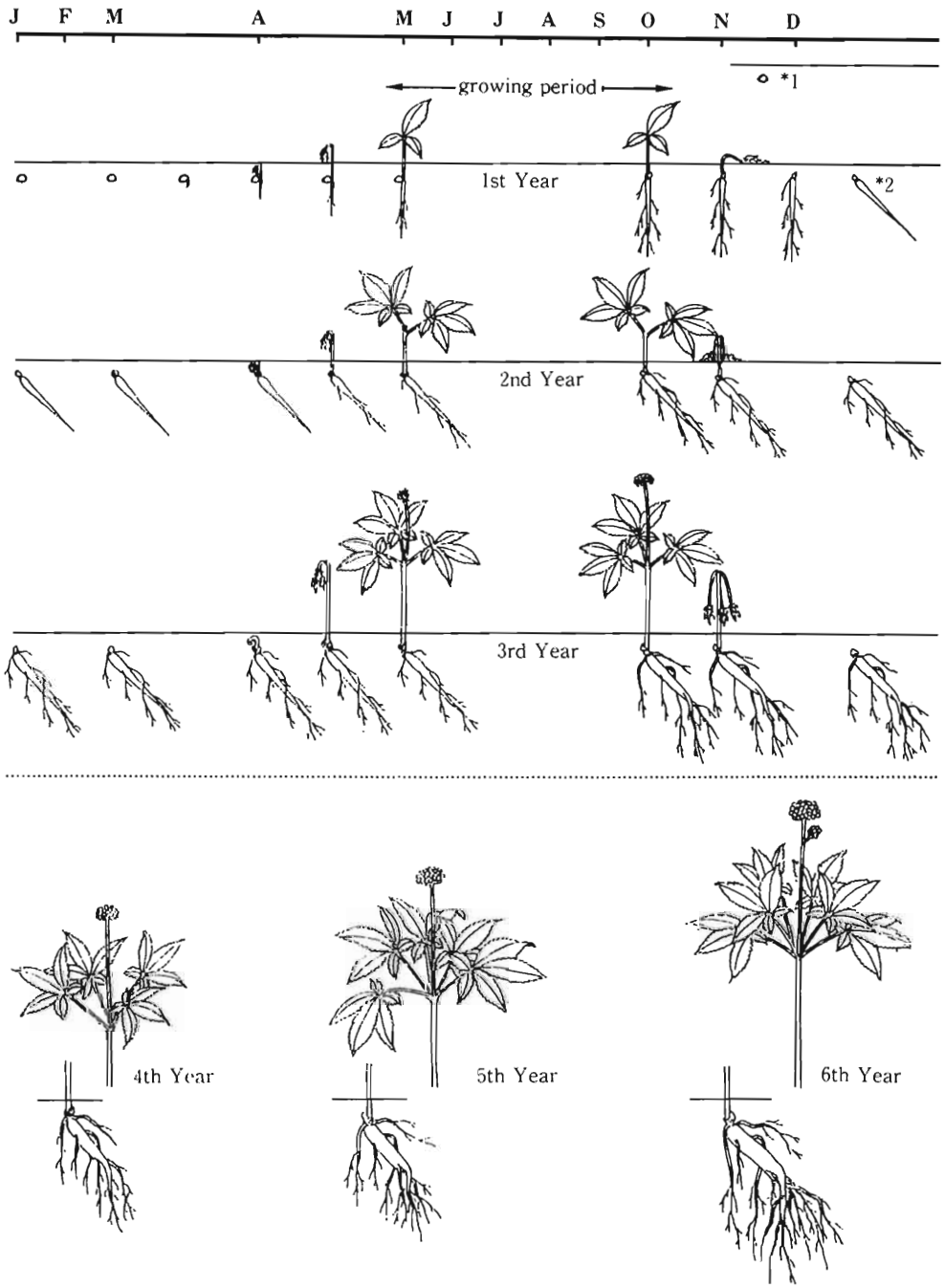

Fig. 1 A Diagram showing the growth and development of ginseng plant cultivated for 6 years at Nagano, Japan

*1 seeding at November in the preceeding year

*2 transplanting at December

Thailand imports ginseng from Hongkong, Singapore and China in many types of product forms: dried root, extract, beverage and tablet. The amount is however not yet published[2].

3. Environmental requirements of ginseng

Ginseng grows natively as a shade plant beneath trees in the mountainous area of temperate China, Russia and Korea. In Japan, ginseng can be cultivated successfully only on Nagano, Fukushima and Shimane Prefecture, The plants, however, are typical perenial herb and owing their slow growth rate, the farmers hervest the roots ordinaly after six years from germination in Nagano, Japan. As shown in Fig. 1, they develop only one shoot with definite number of branches and leaves after long period of period of dormancy every year. Their active photosynthetic period is only about 5 months an year. From the long experience in growing ginseng, Miyazawa reported that the environmental requirements for ginseng cultivation in Japan could be concluded as follows[3,4].

1) Light intensity

Ginseng requires a relative low light intensity for the normal growth. Experientially, the optimum sun light intensity for growing ginseng should be about 4,000 lux at Nagano. Increase of irradiance up to 30,000-40,000 lux would caused a strongly leaf necrosis or sun burn, whereas the low light intensity of 1,000 lux is too low to sustain the growth.

2) Air temperature

Ginseng needs an optimum air temperature of 25-28°C for growth. The plant has a relatively high capability of cold-resistance. A high air temperature above 35°C readily damages the plant growth.

3) Air humidity

The average air humidity of 40% seems to be optimum for the plant growth. The lower humidity tends to be more advantage than the higher, since the high air humidity together with the high temperature usually causes severe problems of damages by pest and disease.

4) Soil condition

Volcanic and loamy soil are suitable for the plant development. Especially, the loamy soil makes the best soil condition, due to its good drainage and appropiate moisture content. The light and perforable soil particles allows the good penetration and expanding of the root system during the development. Moreover, harvesting will also be easily done with a less root damage under such soil condition.

The optimum soil moisture content is about 60% and the optimum soil pH is 5.0~5.5. Ginseng plants grown on the soil with lower pH value (4.0) or higher value (6.3) produced the unhealthy leaves with the necrotic appearance.

Soil should be rich in organic matter to offer both the good physical properties and the nutritional supply.

4. Possibility of cultivation in Thailand

To figure out the possibility of cultivating ginseng in northern Thailand the microclimate differences should be carefully analyzed. Some metheological data at Nagano, Japan and Ang Khang, Thailand are shown in Table 1. Among the environmental requirements for normal growth of ginseng Miyazawa[3,4], two parameters of climatic conditions, temperature and daylength, should be the main limiting factors for a successful ginseng cultivation in Thailand. The other factores; light intensity, air humidity and soil conditions, could be technically adjusted

Table 1. Comparison of some meteological data at Nagano, Japan with those at Ang Khang Royal Project Station, Thailand

Month	Nagano, Japan[1]					Ang Khang, Thailand[2]		
	Developmental stage of ginseng [cultivation practice]	Air Temp.		Soil Temp. (10 cm)	Day-length (hr)	Air Temp.		Day-length (hr)
		Max.	Min.			Max.	Min.	
Jan.	Dormancy	4.4	−6.9	1.8	10.13	21.7	2.4	10.9
Feb.	Dormancy	4.2	−7.1	2.4	10.56	23.9	3.9	11.3
Mar.	Dormancy	8.3	−3.5	3.9	11.49	27.7	9.7	11.9
Apr.	Bud/Seed start to develop. Leaf expanding, Flower buds bolting	16.4	2.4	9.2	12.55	27.8	13.7	12.5
May.	Flowering	22.9	7.3	13.4	14.10	27.4	15.2	13.0
Jun.	Fruit development	23.6	12.3	18.3	14.30	24.5	17.3	13.2
Jul.	[Fruit harvesting, seed stratification (Until early Aug.)]	26.9	16.5	21.8	14.40	24.1	17.1	13.1
Aug.	[GA_3 -treatment, stratification] (After 6. Ang.)]	28.9	17.8	24.3	13.22	23.3	16.6	12.7
Sep.	[Root harvesting]	24.1	14.2	21.7	12.20	24.2	15.3	12.1
Oct.	Senescence start	17.6	6.5	13.6	11.16	22.9	14.1	11.5
Nov.	Dormancy, [Seeding]	12.6	0.6	8.1	10.26	20.8	8.9	11.1
Dec.	Dormancy, [Transplant of the roots]	7.7	−4.7	1.6	9.52	19.0	4.1	10.8

[1] Kitamimaki Experimental Station, Nagano Prefecture (10 years average)[5]
[2] Ang Khang Royal Project Station, Thailand (1991)

without any difficulties.

Ginseng plants grown in Nagano, Japan have an active developmental period only in the season from late April to mid October. From late October to March of the next year the plants stay in a dormancy (Fig. 1). Data shown in Table 1 suggest that ginseng grows and developes well under day temperature of 16~28°C and daylength of 14 hours. A slowly decrease of soil temperature to be 1.6-1.8°C in December and January might be necessary for breaking bud dormancy in the basal portion of the stem above the main root and promoting the seed germination.

The enviroumental condition in northern Thailand should have both the advantage and disadvantage for growing ginseng plant when compared to those in Nagano Prefecture, Japan. The air temperature, ranging 19~28°C throughout the year, in mountainous area of northern Thailand (Ang Khang Royal Project Station, 1500 m. above sea level) is advantage for the growth. However, it has insufficient low temperature for breaking bud dormancy. The daylength may be also too short for ginseng plant to prevent shoot senescence in Thailand (Table 1).

The question about the possibility of cultivating ginseng plant in northern Thailand can therefore be answered with "yes", if the following conditions are satisfied and some technologies are established.

1) Low temperature required for breaking bud dormancy or for promoting seed germination must be partly supplemented artificially with a proper technology by using some growth regulators.
2) A short daylength must be prolonged by supplemental illumination to delay the shoot

senescence and achieve their full development by increasing the growing days at Ang Khang in north Thailand, where it has a optimum air temperature all the year round (Table 1).

3) Ginseng is a typical shade plant and its photosynthetic apparatus (green leaves) is very succptible to light injouy under strong day light.

Therefore, the low photosynthetic productivity under low light intensity shoud by compensated by the low respiration loss at relatively low temperature during night time. One obstacle to cultivating ginseng plants successfully at Ang Khang in north Thailand may be the ambient night temperature about 10°C higher than at Nagano in Japan (Table 1).

Recently some researchers suggested the effect of applied CO_2 on prevention of the light injouy in some experimental plants[6,7]. If the ginseng plants could be grown under high day light intensity than 5,000 lux. for example, and keep the leaves green in more long duration at northern Thailand, we may expect a possible cultivation of ginseng plants. In this context, we have started several experiments to search the possibilities of successful cultivation system of ginseng at Thailand.

5. References

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タイ国における薬用ニンジンの栽培学的研究（第1報）異なった環境条件下における栽培の可能性について

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要 約

薬用人参，*Panax ginseng*，は日本では長野県を主産地として，他に島根県，福島県などの限られた地域で栽培されている。本植物は典型的な多年生の陰生植物で，特殊な栽培条件を要求し，通常6年目に根部が収穫される薬草である。しかし，本薬草の市場における収益性に着目して，タイ北部山地域での（ケシ栽培に替わる）換金作物としての栽培化を検討するために，タイ国チェンマイ大学と近畿大学との共同研究が発足した。この報告では，特に薬用人参の成育のための環境要求性に基づいて，長野県の主産地とタイ北部山地の試験地の気象データを比較し，タイ国における栽培の可能性を考察した。その結果，両地域の気象条件の差異にもかかわらず，いくつかの適当な栽培技術の開発を前提として当地域における薬用人参の栽培が有望であると考えられた。