

Study on the Wild Ginseng and Cultured Ginseng in Northeast of China

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ABSTRACT

The northeast of China is the main productive area of wild ginseng, including Changbai Mountains the south of Little Xingan Mountains, Wanda Mountains and Zhang Guangcai Mountains. The author has been observing the ecological environment of ginseng in more than 20 sites for 20 years and obtains a great deal of ecological environment data about the growth and development of ginseng. This research can provide theoretical basis for the development of ginseng culture and the protection of ginseng resource.

Method of Research

Observations and experiments were carried out at more than 20 sites in the natural habitat of ginseng in Changbai Mountains, Wanda Mountains, Little Xingan Mountains and Zhang Guancai Mountains. Ecological classification and comparison were made to 56 wild ginseng plants that were 1-30 years old and 11 of them were extraordinarily big as 100-500 g. Nine permanent microclimate observation stations were set up located at different topographies in Xianfeng forest farm, Yilan County. Data of different growth stages of ginseng were collected.

Characteristics of the Growth of Ginseng

Ginseng is perennial herb and only more than 15-year-old is; they can be used as medicine. According to characteristics of the growth of ginseng, four stages are divided:

Germination stage of ginseng seeds

Seeds were planted in the natural condition in 5 cm of depth of fertile soil and the soil moisture is about 35%. According to field investigation, during the period of time of the seed coats splitting (the average ground temperature is 16-17.8 °C then) the soil temperature decreases and the process of germination can be divided into four periods as follows: (1) Embryos are visible round points and the average ground temperature is about 21 °C; (2) Embryos grow from points to half big as endosperm and the average ground temperature is 16.5-17.4 °C. (3) From the embryos are half as endosperm to the seed coats splitting and the average ground temperature is 11-12 °C. After 50-60 days seeds began

to spilt and 82 days the rate splitting were 90%. (4) Embryos continue to grow. After 108 days low temperature treatment, the rate of germination was 88.9%. If seeds were treated with 3 months of 5 °C low-temperature treatment, the rate of germination was as high as 90% after 20 days of planting, while the air temperature was 11.8-15.2. From investigations, author made a conclusion that, sowing seeds that were gathered the same year usually could not germinate the next year because there would be no suitable temperature for embryo to grow. To promote the cultivation of ginseng, it is important to understand the characteristics of the germination of ginseng seeds to adjust planting method and planting time to local conditions. For instance, after treat seeds with 100 ppm gibberellin, seed coats began to split in 17 days and the rate of splitting was 77.3% in 40 days. Using gibberellin treatment, the lengths of seeds' embryos were bigger than that of control.

Nutritional growth stage of ginseng

After germination of the seed under suitable condition, roots and stalks begin to grow and three leaves appear. The period of time that from germination to 2-3 compound leaves appear (before bolting and flowering) called nutritional growth stage, which accumulate nutrient for the next growth stage, the reproductive growth stage. According to the characteristics of the metabolism of sugar and nitrogen of the roots and leaves of ginseng, roots and leaves of ginseng have optimum growth in 14.8-15.2 °C and it takes 2-3 years for the seedling to have 5 leaves. The organs and tissues of seedling begin to differentiate gradually and there are visible difference among main roots, lateral roots and fine roots.

Reproductive growth stage of ginseng

Between the south of Little Xingan Mountains and north of Zhangangchai Mountains, after a ginseng grow 5-10 leaves, it has already been 3-6 years. With leaves growing in number, net photosynthesis increases. So nutritive material accumulates continuously in the root of ginseng. This creates material condition for reproductive phase. Generally a ginseng is in flower from June to July and seeds from July to August.

Ripe phase of ginseng

After a ginseng is five years, ten leaves gradually add up to 20-25 leaves and photosynthesis increases and net photosynthetic production accumulates in the root. So the root rapidly expands. After a ginseng is ten years, it can be harvested. Root growth rate decreases year by year beyond ten years. Therefore, the optimum phase for harvesting is ten-year ginseng. Or ginseng infection rate is very high and it easily rots.

Ginseng's Demands to Ecological Factors

Temperature

Chang Bai Mountains, Zhang Guang Cai Mountains, Wan Da Mountain and Xiao Xing An Mountains is the zone that is most suitable for ginseng growing, because under the forest, climate is cool and air is moist and illumination is weak and soil is fertile and water is adequate.

Ginseng's growth phases demand different temperatures. According to observation, when day average temperature steadies in 5~7℃, ginseng roots start an action. In 10~12℃ beginning to grow seedlings. In 12~14℃ starting to spread out leaves. In 18~21℃ flowering and following into red fruit phase. According to the observation and analysis result to the especially big ginseng in the north of Zhang Guang Cai mountains, the most suitable temperature for ginseng adding to weight (20 days) is average 16~18℃. The period's soil temperature from seeding to withered gradually decreases from 18℃ to 11℃. If the air temperature is beyond 30℃, ginseng growing will be inhibited. Ginsengs endure cold. Roots live through the winter in soil. When the temperature is 40℃ below, it still has life. But it is afraid of sudden change temperature in early spring. This creates cuticle cells destroyed. So it catches an illness, rots and is dead. Ginsengs live through the severe cold winter in deep forest, 0.6~0.7 gloomy degree, relatively thick dead branch and leaves.

Illumination

The results of the illumination facts polytrial test and analysis for the environment of ginseng show that the average intensity of illumination for ginseng's development is 4000~5000 lux. So on the basis of the illumination conditions in the greenhouse that ginseng needs it's a measure enhancing ginsengs' production to improve illumination conditions in the greenhouse that ginsengs live in.

Ginsengs are sciophytes, need weak illumination and don't like strong illumination. So when ginsengs are cultured, the field ridge should be illuminated by scattered light, except that during 10:00 am to 2:00 pm, strong light is used a little. By this way, the production and quality of ginseng can be improved significantly.

Moisture

The tidal condition is fit the growth of ginseng. Wetting soil and high-humidity air is beneficial to the development of ginseng. The results of observation and analysis show that the humidity of 30~60% at the layer of 5~15 cm in soil is helpful to the growth of ginsengs. During the time of germination of seeds, moisture content in soil must maintain in 40~55%, and after the seeds have breached, the water content in the earth may be contained about 20~30%; the course form seeds of wild ginseng having opened up to the period of seedlings having opened up the leaves, that 30~40% soil humidity is good. The course form seedlings having opened up the leaves to blossom and

bear fruit, the 40~60% soil humidity is fit, but from final phase of bearing fruit to before freezing weather. In all, the growth of wild ginseng needs moist environment; the relative average humidity annually is more than 55~60%, the yield of ginseng is higher.

Soil

In 8~10 month every year, persons in crowds entered into mountains to excavate wild ginseng at Zhangguangcai Mountains, Xiaoxingan Mountains, and the regions of Liaoyeling Mountains. Through the analysis of wild ginseng, growing area by 50~500 gram from the place of excavating wild ginseng, the soil thickness is 10~82 centimetes, more than half of soil is brown, sandy loam: the coat of soil is comparatively deeper and thickness; the quality of soil is loose and fertile, the quality of permeating water and ventilating air is well. Here the three patterns/forms (solid, liquid and gas) and four qualities/factors (moisture, fertilizer gas and heat) is coordinated, the soil contains 25~50% of fine soil and sticky soil which is fit not only to keep water and fertilizer, but also to circulation of air, the pH value of soil is 5.6~6.0 that presents minute acidity.

Chemical element

1) Nitrogen is a indispensable composition which is relative to the enzymes which participate in the metabolisms of wild ginseng, vitamin and nucleic acid and so on. During the growth of ginseng, rationally increasing the nitrogen in the earth can improve the growth of leaves, increase/raise the content of chlorophyll and enhance the strength of photosynthesis, therefore improve the yield of ginseng. When lack of nitrogen, individual plants are short and small, the blades are light green and turn yellow little by little, the growth is controlled; the capacity of disease-resistant of ginseng is reduced which affects the yield and quality of ginseng.

2) Phosphorus can participate in photosynthesis, promote the development of root system and the growth of individual plants, at the same time, can strengthen the capacity of cells bondage to water content and increase the capacity of drought-resistant, cold-resistant and disease-resistant. We discovered from the observation of the fixed points that when lack of phosphorus, the individual plants grow slowly and is short and small, the blades are dark green, and lack of sheen/gloss and occur bronze-color or purple spots at the edge of leaves.

3) K can promote transform and transport of ginseng photosynthesis production and strength tough and tensile quality of stem. The stem doesn't easily lodge. And this improves roots' production. Applying plant ash K can heighten normal physiological function of stoma and adjustable ability of stoma opening, promote the normal development of ginsengs' transport tissues, strengthen plant drawing water power and keeping water power and enhance resisting cold ability. When ginsengs are lack of K, apex and edge become yellow at first, nearby of vein is dark green, leaves edges curl and hang down and root development is not good, easily catch an illness and rot.

4) Trace element such as Bi, Mn play an important part in ginsengs' development. Bi plays a catalytic agent part in ginsengs' metabolism and improves sugar metabolism, promote ginsengs' organism and sugar accumulating. Mn can stimulate ginsengs' (5 years growth) growing points' new issues to form, promote 7-year ginsengs' photosynthesis and plant growth.

Slope Directions and Solar Radiation Amount to Ginsengs Influence

Through observation, it is obtained that under different weather, the daily average air temperature of north slope is lowest, the second is east slope and west slope. The south slope is highest.

All the slope directions accept different solar radiation amount, so their soil temperature differences are very big. 5 cm soil temperature of the south slope is highest. The second is the west slope and the east slope. The lowest is the north slope. At the place where the especially big ginseng was found through observation in the northeast of Xiao Xing An Mountains and Zhang Guang Cai Mountains, it is obtained that 15 cm soil moisture of south slope is the lowest. The second is south-west slope and west slope. The highest is north slope and east slope. The main vegetation of this region is Korean pine, linden, walnut tree and Birch. Density is 0.6~0.7 or so. There are kinds of herbaceous herbs under forest.

Through small climate observations of different slope, it is obtained that the south slope accepts much solar radiation amount. The temperature is high. The moisture is low. Day difference of the air temperature is big. On the contrary, the north slope accepts little solar radiation amount, the temperature is low, the moisture is high, and day difference of the air temperature is small. Through small climate reaction of slope direction, north slope and east slope is beneficial to ginseng. The production of ginseng is high and quality is good. This offers scientific basis for us to cultivate ginseng. Under the suitable conditions of topography and soil, we should make most use of the small climate reaction of north slope and east slope to develop ginseng production.

Conclusions

The conclusions as follows are obtained through the study of the climatic ecological environmental observation to wild ginsengs in fixed locations:

Ginsengs need cool, moist, weak illumination and long-day climatic ecological environment. The suitable growing season of wild ginsengs development: $T > 12^{\circ}\text{C} \sim 13^{\circ}\text{C}$, long-standing temperature $2500 \sim 2700^{\circ}\text{C}$, the average air temperature of the hottest month (July) is 21°C or so. Year-average relative humidity surpasses 75% or so. Intensity of illumination is $4000 \sim 5000$ (Lux).

Ginsengs live in 0.6~0.7 density conifer and hardwood forest on the basis of Korean pine and linden at high slope, and it grows better at east, north and south slope. So we should make most use of

the small climate reaction of north slope and east slope to cultivate ginsengs.

The ecological environment of 0.6~0.7 density and even trees is relatively beneficial to cultivate ginsengs.