

THE ECOLOGY, PHYTOGEOGRAPHY AND ETHNOBOTANY OF GINSENG

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Abstract

Ginseng is the English common name for the species in the genus *Panax*. This article gives a broad botanical review including the morphological characteristics, ecological amplitude, and the ethnobotanical aspect of the genus *Panax*. The species of *Panax* are adapted for life in rich loose soil of partially shaded forest floor with the deciduous trees such as linden, oak, maple, ash, alder, birch, beech, hickory, etc. forming the canopy. Like their associated trees, all ginsengs are deciduous. They require annual climatic changes, plenty of water in summer, and a period of dormancy in winter.

The plant body of ginseng consists of an underground rhizome and an aerial shoot. The rhizome has a terminal bud, prominent leafscars and a fleshy root in some species. It is perennial. The aerial shoot is herbaceous and annual. It consists of a single slender stem with a whorl of digitately compound leaves and a terminal umbel bearing fleshy red fruits after flowering. The yearly cycle of death and renascence of the aerial shoot is a natural phenomenon in ginseng.

The species of *Panax* occur in eastern North America and eastern Asia, including the eastern portion of the Himalayan region. Such a bicen-

tric generic distributional pattern indicates a close floristic relationship of the eastern sides of two great continental masses in the northern hemisphere. It is well documented that genera with this type of disjunct distribution are of great antiquity. Many of them have fossil remains in Tertiary deposits. In this respect, the species of *Panax* may be regarded as living fossils. The distribution of the species, and the center of morphological diversification are explained with maps and other illustrations. Chemical constituents confirm the conclusion derived from morphological characters that eastern Asia is the center of species concentration of *Panax*. In eastern North America two species occur between longitude 70°–97° W and latitude 34°–47° N. In eastern Asia the range of the genus extends from longitude 85° E in Nepal to 140° E in Japan, and from latitude 22° N in the hills of Tonkin of North Vietnam to 48° N in eastern Siberia. The species in eastern North America all have fleshy roots, and many of the species in eastern Asia have creeping stolons with enlarged nodes or stout horizontal rhizomes as storage organs in place of fleshy roots.

People living in close harmony with nature in the homeland of various species of *Panax* have used the stout rhizomes or the fleshy roots of different wild forms of ginseng for medicine since time immemorial. Those who live in the center morpho-

logical diversity are specific both in the application of names for the identification of species in their communication and in the use of different roots as remedies to relieve pain, to cure diseases, or to correct physiological disorders. Now, natural resources of wild plants with medicinal virtue are extremely limited. In order to meet the market demand, three species have been intensively cultivated in limited areas. These species are American ginseng (*P. quinquefolius*) in northeastern United States, ginseng (*P. ginseng*) in northeastern Asia, particularly in Korea, and Sanchi (*P. wangianus*) in southwestern China, especially in Yunnan. At present hybridization and selection for better quality, higher yield, and more effective chemical contents have not received due attention in ginseng culture. Proper steps in this direction should be taken immediately, so that our generation may create a richer legacy to hand down to the future. Meanwhile, all wild plants of all species in all lands should be declared as endangered taxa, and they should be protected from further uprooting so that a fuller gene pool may be conserved for the genus *Panax*.

Introduction

Here we gather again for mutual exchange of information on ginseng obtained from various research projects in our respective fields. In the ginseng symposium which took place in Singapore, in February 1976, I advocated a wider cultivation of ginseng so that the price of the product may be brought down, and that more people may use the products as health food, instead of an expensive medicine. I was indeed happy when I received the announcement of today's symposium and saw that two of the three major subjects to be dealt with in this meeting will be ginseng culture and ginseng as health food.

Today I should like to make a broad botanical review about ginseng. All of us in this auditorium share a common interest which is ginseng. We are ginseng scientists, ginseng administrators, ginseng businessmen, and even ginseng reporters. We need a broad view and a vision for ginseng so

that our work with it may be of wider application and better service to the people. The subject is complex, but I shall limit the discussion to three areas: (1) ecology—ginseng and its environment, (2) phytogeography—ginseng in the world, and (3) ethnobotany—man and ginseng. In dealing with these three aspects, we may find the answers to questions such as these. Where can we find ginsengs? How many species are there? What do they look like? How can man make better use of them?

The Ecology of Ginseng

Ginseng is the English common name for the species of *Panax*. In the market, the root of *P. ginseng* produced in China is called ginseng (人參), and that produced from Korea is called Korean ginseng (高麗參). The root produced in USA from *P. quinquefolius* is called American ginseng (西洋參, 花旗參). The product from *P. wangianus* is called Sanchi or ginseng sanchi (三七, 人參三七). The species of ginseng frequently seen in botanical literature are the dwarf ginseng (*P. trifolius*) from eastern USA, the Himalayan ginseng (*P. pseudoginseng*) from Nepal and the eastern Himalayan Region, the Japanese ginseng (*P. japonicus*) from eastern Asia, the double cut leaved ginseng (*P. japonicus* var. *bipinnatifidus*), and the pearl ginseng (*P. elegantior*)¹⁾ from western China.

All the above mentioned species of ginseng and the lesser known ones are undergrowth of cool humid deciduous forests of the temperate zone, or in high altitudes of the subtropic and warm temperate zones of eastern Asia. They usually occur on steep slopes or on rocky banks along the margin of broad-leaved forests sometimes mixed with hemlock (*Tzuga canadensis* in USA, and *T. chinensis* or *T. yunnanensis* in western China). Deciduous trees such as alder, ash, beech, birch, hickory, linden, maple, and oak are associates of ginseng. In the forest, ginseng grows between or over rocks covered by a thick layer of rich soil loose in

1) *Panax elegantior* (Burk.) Hu, S. Y., *stat. nov.* Basonym: *Aralia quinquefolia* Decne. var. *elegantior* Burk. in *Kew Bull.* 1902: 8. 1902.

texture and black in color. Ginseng requires annual climatic changes, plenty of water in summer, and a dormant period in winter.

The plant body of ginseng is adapted for an annual cycle of death and renascence. It consists of an underground rhizome with a terminal bud and a herbaceous aerial shoot. In ginseng, American ginseng and Sanchi ginseng, the rhizomes are erect and each is connected to a fleshy root with branches. In older plants, adventitious roots may develop from the lower nodes of the rhizomes. In the Japanese ginseng, the rhizome is horizontal, stout, with short internodes, and having the appearance of a piece of bamboo, hence the Chinese name bamboo ginseng (竹節參). In the pearl ginseng, the rhizome is slender and with elongated internodes and enlarged nodes, giving the appearance of a string of pearls. The terminal bud of a rhizome develops into the aerial shoot in the spring. On the death and disintegration of the shoot, a scar is left on the rhizome. In all species, except the pearl ginseng, the shoot-scars are prominent. These scars provide a good character for estimating the approximate age of the plant, for they are added annually.

The Phylogeography of Ginseng

Botanical literature published 100 years ago contains more species of *Panax* than the numbers that we are recognizing now. For example, in the 1880s, when B. Daydon Jackson compiled the Index Kewensis, he listed 134 species of *Panax*, and treated 64 of them as valid. After careful studies of more recent botanists, many of the species formerly published as *Panax* have been transferred into *Acanthopanax*, *Dendropanax*, *Heteropanax*, *Nothopanax*, and even into *Aralia*, *Eleutherococcus*, and *Schefflera*. Now, botanists generally adopt a more restrict definition for the genus *Panax* and leave a more natural group of species in it. Typified by *P. quinquefolius* L., *Panax* contains only the species with an underground morphogenetic point, an aerial shoot a whorl of digitately compound leaves, serrate, double-serrate, or pinnatifid-serrate leaflets, terminal umbellate inflorescence, small flowers, 5 petals,

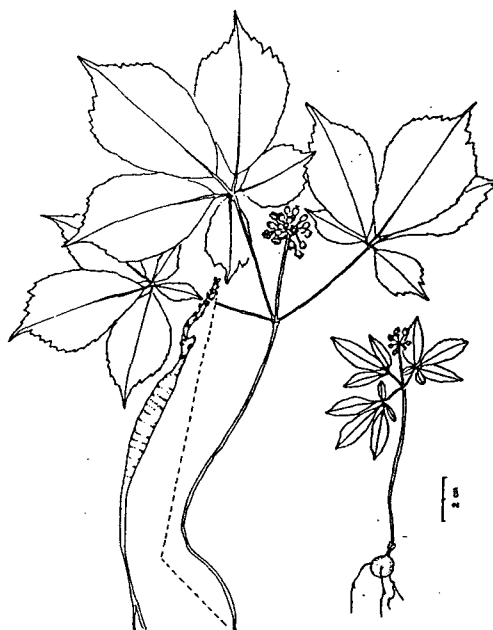


Fig. 1. The ginseng in America: a. *Panax quinquefolius*, showing spindle-shaped root and obovate leaflets. b. *Panax trifolius*, showing spherical root and oblong leaflets (See text for more explanations).

inferior ovary, and fleshy red or orange fruits each containing 2 or 3 pyrenes (Fig. 1-a). By this definition, the genus *Panax* has two species in eastern North America and six species in eastern Asia.

Descriptive Geography of Ginseng: The two species of ginseng in eastern North America are the American ginseng (*P. quinquefolius* L., Fig. 1-a), and the dwarf ginseng (*P. trifolius* L., Fig. 1-b). The American ginseng has a large spindle-shaped, often forked fleshy root, a tall stem 15–30 cm. long, large, mostly 5, thin, obovate-oblong pointed leaflets and bright red fruits. It occurs in rich and cool woods, extending from Quebec westward to Manitoba in Canada, and thence southward to Florida, Alabama, and Oklahoma in USA. It was used as a medicine by the American Indians since time immemorial, and is now cultivated for Chinese trade.

The dwarf ginseng is a much smaller plant. It has a spherical fleshy root, delicate stem 10–20 cm. long, 3 to 5 oblong sessile leaflets, and yellowish fleshy fruits. It occurs in woods and damp clearings extending from Prince Edward Island in

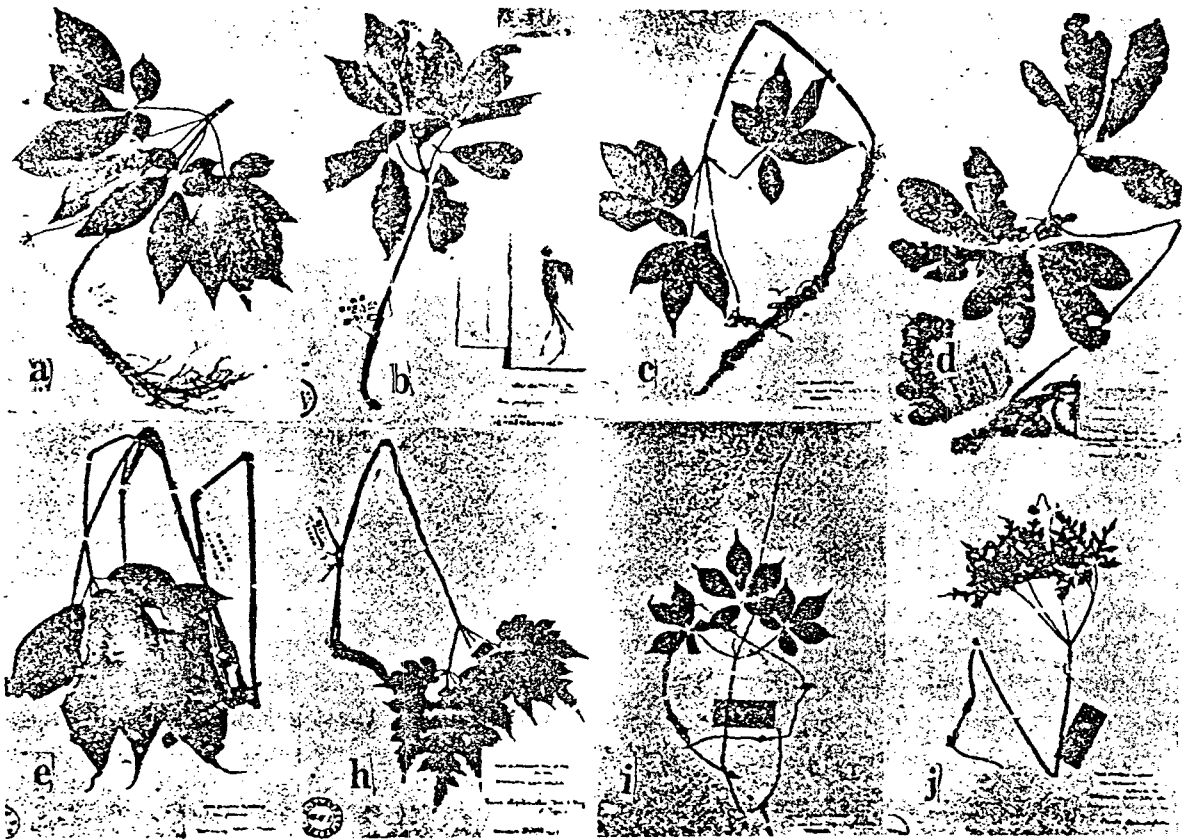


Fig. 2. Explanation on page 153.

Canada westward to Minnesota, and thence southward to New England and northern Georgia, Ohio, Indiana, Iowa and Nebraska. Comparing the occurrence of the two species, *P. trifolius* has a smaller and more northern range than that of *P. quinquefolius*.

The species of ginseng in eastern Asia form a complex. Many names have been proposed and species described by various authors. Here, six species are recognized. These species can be arranged into two groups by the nature of their rhizomes and the feature of their roots. The species with fleshy roots and erect rhizomes are the common ginseng (*P. ginseng* C. A. Meyer, Fig. 2-a, Fig. 4-b), the Himalayan ginseng (*P. pseudoginseng* Wall., Fig. 2-b, Fig. 3), the Sanchi ginseng (*P. wangianus* Sun²⁾, Fig. 4-a, d), and the ginger ginseng (*P. zingiberensis* Wu et Feng, Fig. 4-c.1 and c.2). Species without fleshy root are the Japanese ginseng (*P. japonicus* C. A. Meyer, with four varieties, Fig. 2-c, d, e, f) characterized having hori-

zontal rhizome with stout and short internodes, and the Pearl ginseng (*P. elegantior* [Burk.] S. Y. Hu, Fig. 2-i, j).

The distribution of the ginsengs with fleshy roots are relatively restricted. The common ginseng is widely planted. Its wild form occurs in the Long White Mountain area of the Chinese Northeast and the adjacent Korea. In comparison with the cultivated material, the wild plants have more slender and rather elongated rhizomes and shorter and more branched roots. The Sanchi ginseng is limited to the high mountains of western Szechuan and southeastern Yunnan where it is intensively cultivated for Sanchi, one of the important ingredi-

2) *Panax wangianus* Sun in Fang, Icones Plant. Omei. 2: t. 194. 1946. *P. notoginseng* (Burk.) F. H. Chen in Acta Phytax. Sin. 13(2): 41. fig. 6.3. 1975 based on *Aralia quinquefolia* (L.) Decne et Planch. var. *notoginseng* Burk. obviously is a later binomial for Sanchi. The species is characterized by having 5 or 7 leaflets. A photograph of *P. notoginseng* (Burk.) Chen that accompanies the proposal of the name matches the picture of *P. wangianus* Sun very well.



Fig. 3. The Himalayan ginseng-*Panax pseudoginseng*: A. A portion of an aerial shoot showing the ovate elliptic, serrate or double-serrate leaflets, and a branched inflorescence. B. The underground portion of a plant showing the shootscars on the erect rhizome, a branched root, and adventitious fleshy roots attached to the base of the rhizome, and the basal portion of the stem (Redrawn from Wallich, Pl. Asiat. Rar. 2: t. 137. 1831.).

ents of the famous and widely distributed Yunnan Pai Yueh (雲南白藥). The Himalayan ginseng occurs in Nepal and thence eastward to northern India, northern Burma, and southeastern Tibet. The ginger ginseng recognized by numerous tuberous fleshy roots on short rhizome is extremely restricted to southeastern Yunnan.

Figure 2 shows herbarium specimens of Asian species of *Panax*: a. The flowering plant of cultivated *P. ginseng* showing a short erect rhizome, a cylindrical fleshy root with numerous branches, 4 verticillate digitately compound leaves, each with 5 petiolate leaflets, and a simple terminal umbel b. A fruiting plant of *P. pseudoginseng* showing the aerial shoot detached from the underground erect rhizome and a branched fleshy root. c. A flowering plant of *P. japonicus* showing a horizontal rhizome

with stout and short internodes, prominent shoot-scars, and persistent fibers of the disintegrated bud-scales or stem. d and e. Two specimens of *P. japonicus* var. *major* (Burk.) Wu and Feng³⁾. h. A flowering plant of *P. pseudoginseng* var. *bipinnatifidus* Wu and Feng showing the lobed and serrate leaflets. i. A flowering plant of *P. elegantior* showing the creeping rhizome with slender elongated internodes, and enlarged nodes, a whorl of 3 digitately compound leaves, and a terminal umbel with flower buds. j. A flowering plant of *P. elegantior* var. *pinnatifidus*⁴⁾, showing a portion of the slender rhizome enlarged at the node, and 4 digitately compound leaves with pinnatifid leaflets.

The distributions of the Asian species of ginseng without fleshy roots tend to be widespread (Map 1). The Japanese ginseng recognized by its horizontal rhizome with stout and short internodes extends from Japan westward over the warm temperate and the subtropic regions of China to northern India and Nepal. This range covers a territory extending east and west for 50 longitudinal degrees (long. 85°–135° E). The pearl ginseng characterized by creeping rhizome with slender elongated internodes and enlarged nodes shares the western portion of the range of *P. japonicus*. From Yunnan and Szechuan, *P. elegantior* extends northward to southern Shensi and Kansu.

Interpretations: The distribution of the species of *Panax* may help us to understand the antiquity of ginseng, the evolutionary positions of the species, and the reason of their restricted occurrence in eastern North American and eastern Asia.

3) *Panax japonicus* C. A. Meyer var. *major* (Burk.) Wu et Feng in Acta Phytotax. Sin. 13(2): 43. 1975. Burkill described the variety on the basis of *A. Henry* 5396c, 5396g, and 7728. The duplicates of these collections in the Gray Herbarium have horizontal rhizomes with short and stout internodes, and the median leaflets of the compound leaves vary from 17 to 26 cm. in length and 4–12 cm. wide, with the margin evenly double-serrate. They represent a large-leaved variety of *P. japonicus*. Wu and Feng made the correct combination, but they misapplied the name to specimens with creeping slender rhizomes enlarged at the nodes.

4) *Panax elegantior* (Burk.) S. Y. Hu var. *pinnatifidus*, var. nov. A type differ foliolis pinnatifidis, lobis serratis; rhizomatis gracilitus, nodulosis. Hupeh: *A. Henry* 6834 (type, Gray Herb.).

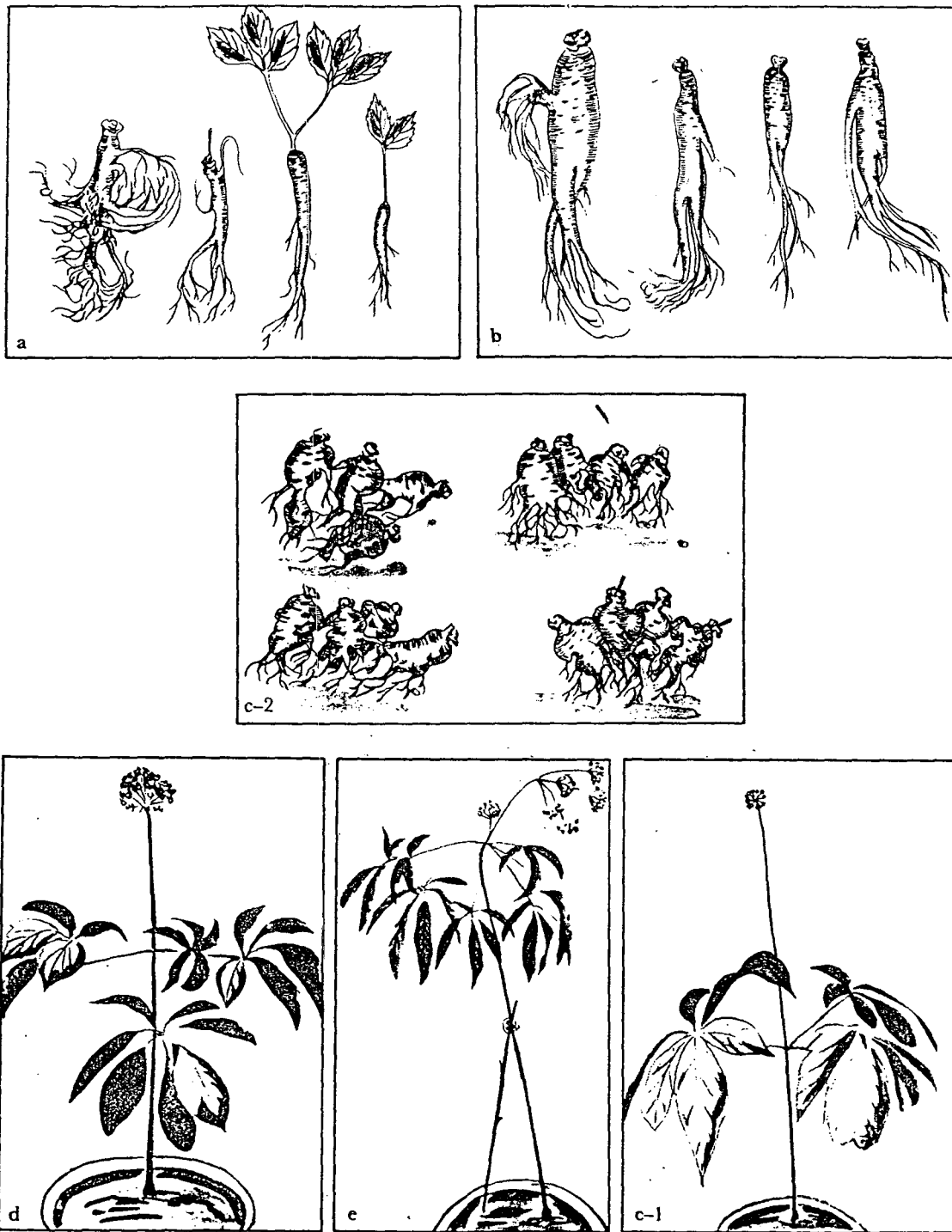
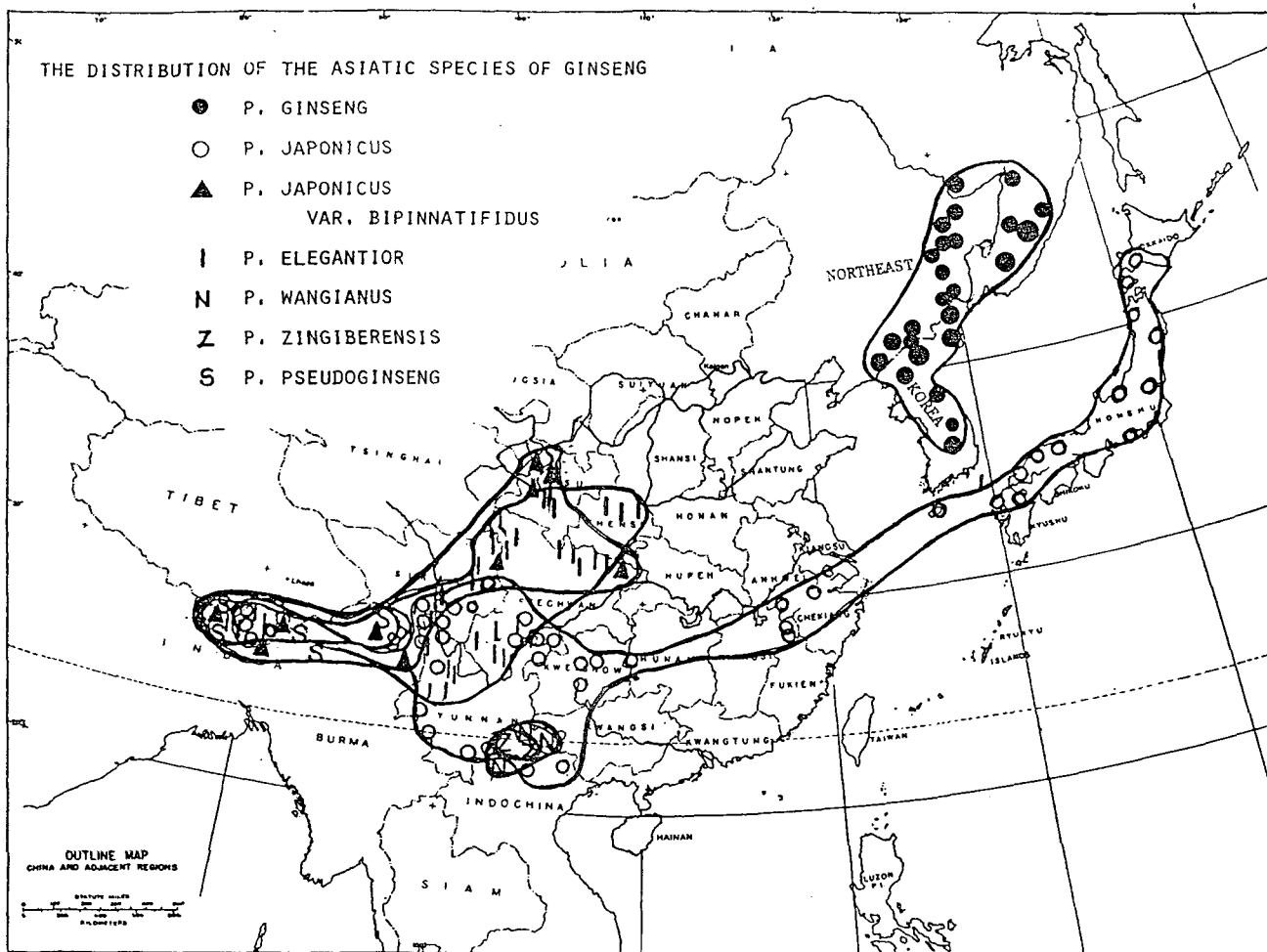


Fig. 4. Five species of ginseng in cultivation: a. Two juvenile plants of Sanchi (*P. wangianus*) on the right, showing an one-year old plant with 1 leaf, and a two-year old one with two leaves; and two fleshy roots on the left, aging 4- and 3-year respectively from the left to the right. The species has short erect rhizome. b. Four fleshy roots of Ginseng (*P. ginseng*), about 4-5 years old, showing erect rhizomes. c-1. An aerial shoot of Ginger ginseng (*P. zingiberensis*), showing a whorl of 3 digitately compound leaves, each with 5 leaflets, and a terminal umbel with flower buds. c-2. Four rhizomes of *P. zingiberensis* showing short and stout rhizomes loaded with tuberous roots. d. A potted plant of Sanchi showing a whorl of 4 leaves each with 5 or 7 leaflets, and a globose umbel with numerous flower buds. e. A fruiting plant of *P. japonicus* var. *angustifolius* showing a branched peduncle with a cluster of umbels.

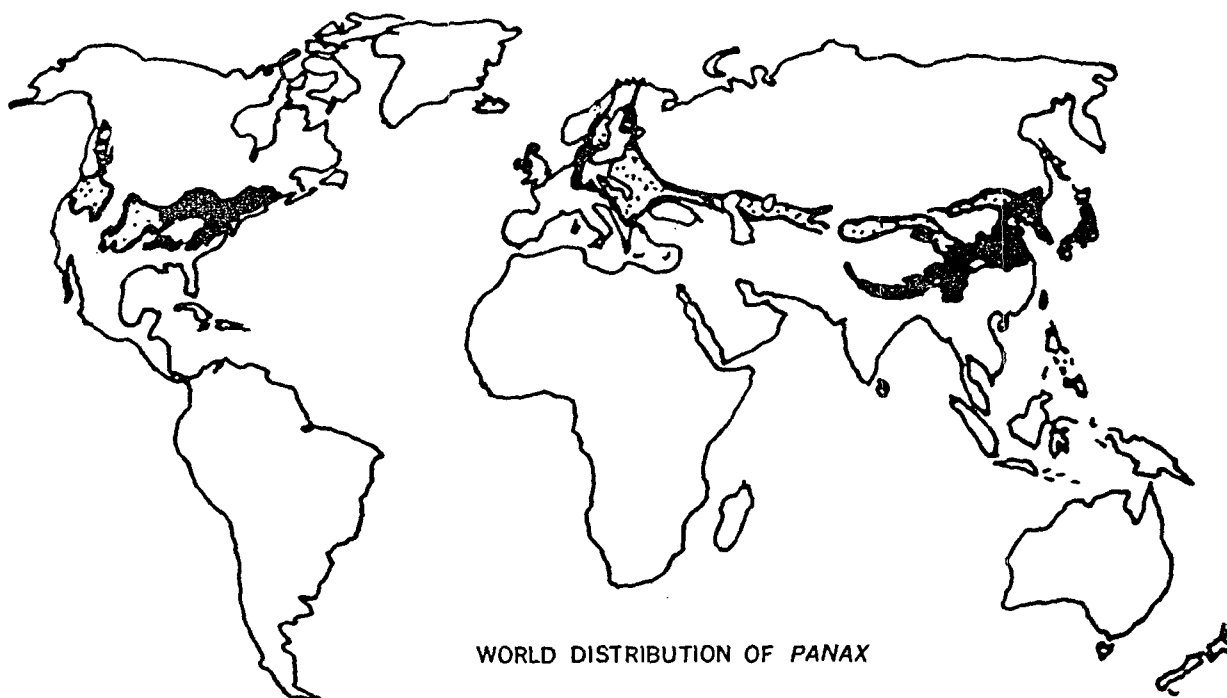


Map 1. A map of East Asia showing the distribution and the area of species concentration of the Asiatic species of ginseng. The most widespread species is *Panax japonicus*, a species with horizontal rhizome. Western China and the adjacent Eastern Himalayan region constitute the area of species concentration and morphological diversification of the genus *Panax*.

The bicentric distribution of ginseng is a classical one in phytogeography. Numerous genera of flowering plants share this pattern of disjunct distribution. Phytogeographers often use this pattern to explain the close floristic relationship of the eastern sides of two continental masses in the northern hemisphere. It is well documented that genera with this type of distribution are of great antiquity. Many of them have fossils in Tertiary deposits. In this respect, the species of *Panax* may be regarded as living fossils. They have been where they are for a long time, perhaps since the Tertiary time in the southern Appalachian and the Ozark mountains, and in China.

The species without fleshy roots have wider ranges than those with fleshy roots. Their ranges extend to the high altitudes of the warm temperate and subtropical zones in China and the adjacent Indo-China and Burma. It is through the species with creeping rhizomes that the relationship between *Panax* and *Aralia* is established, for *P. elegantior* and *A. nudicaulis* L. bear close morphological resemblance. The species without fleshy roots may be regarded primitive taxa in the genus *Panax*, and the species with fleshy roots and erect rhizomes may be interpreted as derived taxa.

The species of *Panax* are adapted for life in cool humid deciduous woods. They require both



Map 2. A map of the world showing an isothermal belt with January temperature fluctuating between -5°C and 5°C , the area with ginseng is black and that without ginseng is shaded (Reconstructed according to the information given in the *Time Atlas*, plate 5.).

a cool shock and complete dormancy in winter and plenty of water during the growing season in summer. Map 2 shows that in Eurasia and in western North America there are isothermal areas (shaded) with the January temperature fluctuating between -5°C and 5°C as the ginseng areas (black). The absence of ginseng from western North America and Eurasia is evidently caused by insufficient rainfall in summer.

The Ethnobotany of Ginseng

All the ethnic groups of people living in close contact with wild ginseng have discovered the usefulness of the plants independently. In China two species have attained the most prominent position in drug market, while all the other available known species are used in form of folk remedies. The two of prime importance in the drug trade are ginseng (*P. gin.eng*) and Sanchi (*P. wangianus*). Material from wild plants for these drugs is very rare. Both now depend upon cultivated material. Both are used in combination with other drugs for various

purposes, but ginseng is used primarily as a revitalizing agent and Sanchi as a hemostatic agent. A large amount of American ginseng is imported to China and used there as a substitute for Chinese material. Consequently wild *P. quinquefolius* is rare in USA. Now, the natural resources of ginseng are extremely low. Many species are on the verge of extinction. The uprooting of wild plants must be stopped immediately. All species of ginseng in all lands must be declared as the endangered taxa, and they should be protected for the conservation of the genes.

Phytochemical research and experimental biology in ginseng have increased our knowledge of the plant, and elucidated the scientific justification of the medicinal use of ginseng. The works of soil scientists and plant physiologists have indeed helped to improve the cultivation of ginseng to meet the market needs. However, all the researches have been centered around one species, *P. ginseng*. We know that the increase of yield of corn, wheat, rice, soybean, and other crop plants depends a great deal upon hybridization and selection, the

introduction of new genetic material and the creation of new types. In ginseng researches, this area has not received due emphasis. To attain this goal, various species must be available. This would mean the establishment of a Ginseng Botanical Garden where various species of ginseng can be cultivated, hybridization and selection may be performed, and where botanists can collect data for a better understanding of the behavior of various species, and for the phase changes of individuals. All these are fundamental for future improvement of ginseng.

Summary

Ginseng is useful. It is economically important. It is adapted for life in a deciduous cool and humid forest. It requires good soil, plenty of water, a period of dormancy. It is old, perhaps over 35 million years old. It calls for human care and protection. Man has the power to destroy or to improve. We should all work for the improvement of ginseng for future generations.

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