

Ginseng (*Panax ginseng*)

Cultivation and agrotechnology



Ginseng plantation in Lahaul, HP

INTRODUCTION

Panax ginseng C.A. Meyer is a perennial herbaceous plant valued for its roots. Ginseng is native to China and called as the 'elixir of life' as it strengthens the metabolism, stimulates the immune system, vitalizes glandular functions, slows down degeneration of cells, increases longevity as well as reproductive potential. It is mostly used as a single herb to reduce stress, enhance blood flow, and help in controlling blood pressure, blood sugar and cholesterol levels. Recently, CSIR-IHBT has succeeded in its introduction and domestication in Himachal Pradesh.

Description: *Panax ginseng* belongs to family Araliaceae. It emerges in late April from the underground perenating roots after snow melt. In the first year, ginseng seedling has three

small serrated leaflets joined at the top of a 5-10 cm stalk. At the onset of winter, the foliage dies and a small perenating bud is formed at the root crown which sprouts and



Three years old ginseng roots

develops next year into a two year old plant with two compound leaves each having 3-5 leaflets terminating a 10-18 cm stalk. In the subsequent years, one compound leaf with 3-5 leaflets is added every year.

Flowering and heading: Flowering starts in late spring or early summer in the third year. The erect flowering stalk arises from the juncture of compound leaves terminating into an umbelliferous cluster of small greenish white flowers. These develop into small green berries in late summer and ripen into bright red berries by early autumn containing flattened round creamy yellow seeds with hard coat.

AGROTECHNOLOGY

Propagation: Ginseng is best propagated by seed. The seeds are recalcitrant and immature at the time of harvest. Thus, they are kept moist and require special handling and stratification treatments till they germinate after about 18 months.

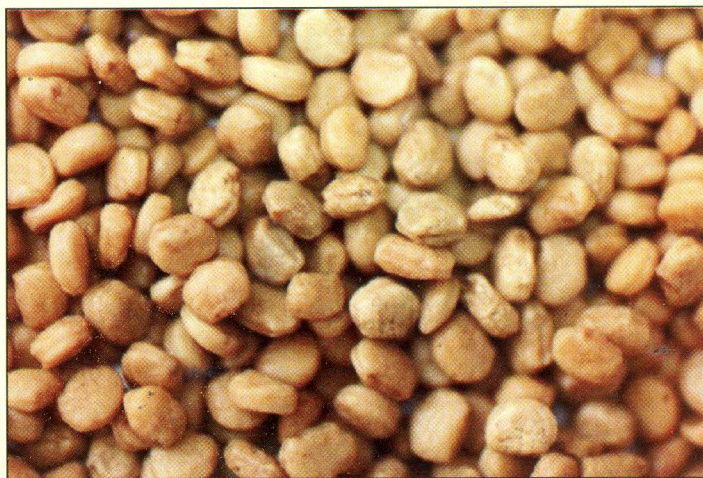
Site selection: The plant can be grown in rain shade temperate areas of the inner Himalayas where the summer monsoons are scanty, but with ensured supply of water to maintain moisture. During perennation in winter months roots do not tolerate sub-freezing environment in the soils and may require mulching during winter months. Ginseng requires 70 % shade for its optimal growth. There are a few niches available in Himachal where it can be grown in temperate broad leaved forests. Areas with deciduous broad leaved trees such as, Acer, Walnut, Oak, Poplar are considered good for forest grown ginseng. Herbaceous plants like *Trilliums* spp., *Podophyllum* sp., *Fragraria* spp. etc. in temperate forests are indicators where ginseng can be grown under natural conditions. However, coniferous stands or other shallow-rooted flora like ferns in the under storey should be avoided. The inner temperate forest areas of Chamba, Kullu and

Kinnaur districts of Himachal Pradesh have the potential for producing forest grown ginseng. Ginseng can also be commercially grown in open valleys like Lahaul in Himachal Pradesh with 70 % shade infrastructure created at the site.

Soil: Ginseng grows best in slightly acid soils with a pH of 5-6.5. Ginseng is a shallow rooted plant and the water requirement is less compared to other conventional crops. It is desirable to select a site with slight gradient for avoiding water logging situation. The ideal soil is loam with high organic matter content or humus.

Bed preparation: The field is ploughed 3-4 times. The seeds or plants are planted in raised beds 10-12.5 cm high, prepared across the contour of land in terraces. The beds should be 120 cm wide and the length can be adjusted according to the contour of soil or the shading infrastructure at the site. The use of farm yard manure (FYM) is not recommended, as it is laden with undesirable weed seeds and insects.

Seed sowing and nursery development: Depending on the site and soil conditions the seeds are sown 12 mm to 25 mm deep. The seeds are covered with enough soil or mulch so that these do not dry. It is essential to cover the seed beds with 2.5-5.0 cm of mulch. The sowing should be done at an uniform depth and spacing to avoid uneven stands. High density sowing, is usually done for nursery



Ginseng seeds



P. ginseng one year old nursery developed from seeds at CSIR-IHBT, Palampur



One year old roots harvested for replanting

development or natural stratification of green seeds in field. Furrows are prepared 15 cm apart along the length of the bed. Seeding is done 2.5 cm apart in each row. However, in low density sowing which is usually adapted in woodland natural shade conditions, the seeds are sown 15-30 cm apart. Consequently, the seeding rate is about 35-100 kg/ ha depending upon the seeding density adopted. The actual seeding rate and other cropping parameters are location specific.

Transplantation: The rootlets produced in first year of growth in the nursery, known as planting stock are transplanted in main field. Plantation is done with proper spacing to obtain disease free plants till the harvest after 5 years of growth. The rootlets are dug out and transplanted immediately to the already prepared beds. The usual spacing for rootlets is 10-15 cm plant to plant, in 15-20 cm apart rows. It is essential to plant the rootlets well before the onset of apical growth to avoid unnecessary damage to the plants.

CULTURAL PRACTICES

After the seed sowing and transplantation, the ginseng field requires specialized crop management, till the crop is harvested after about 5 years.

Mulching: Regular organic mulching of the ginseng beds is done immediately after sowing of the seeds or senescence of aerial parts. The best mulching materials are leaves of deciduous trees and wheat or oat straw. Care should be taken not to mulch with weed or wild grasses which contain seeds. The mulching material should be devoid of any seeds.

Shade management: A shade net structure (70 % shading) is prepared on the area so that no direct sunlight falls on the plants. The sides are left open in such a way that no direct sunlight enters the field but at the same time, there is ample aeration. Traditionally, every bed is covered with a separate thatched structure in Korea and China. The shade cover can be removed after the senescence of aerial parts and is replaced by organic mulch. The shade net should be about 2.4-3.0 m high to allow cultural operations comfortably and reduce temperature and humidity. The posts are planned in a grid formation 4 m apart and dug 15-30 cm deep to support the shading net.

Fertilizer: Ginseng does not require any chemical fertilizer, except that the soil must be rich in humus with adequate moisture. Addition of nitrogen may improve the foliage with little effect on root biomass. The decomposed leaf litter is considered the best manure for ginseng.

Irrigation: Ginseng requires adequate moisture levels, but not wet conditions which may lead to root rot. The ideal moisture level is 40-50 % of the field capacity of the soil. In this respect the site selection, proper shading and appropriate mulching help in retaining moisture levels. Supplemental irrigations may be occasionally required in commercial cultivation. Sprinkler irrigation should be avoided to prevent spreading of pathogenic spores on leaves

PLANT PROTECTION

The main threats to ginseng crop are weeds, insects, pathological diseases and rodents. Only a few pesticides are labeled for use on ginseng. Appropriate measures taken during site preparation will help to control the pest menace.

Weeds: All the weeds should be eliminated before planting. Manual weeding should be done at regular intervals. The use of herbicides is not recommended.

Insects: Another threat to ginseng plants is mainly from grubs and wireworms in the soil damaging roots and slugs, which may damage the aerial parts like leaves, stems and berries. The slugs are mostly associated with mulch. Proper measures like fumigation of infected areas and mulch materials can take care of insect damage. However, in case of severity there are a few recommended chemicals for the insect control in ginseng which may be inquired and got recommended from CSIR- IHB.

Diseases: The diseases of ginseng are mostly associated with poor management, aeration and high density commercial cultivation. The occurrence of disease is maximum in high density plantations. There are about one dozen pathogenic diseases reported in ginseng, but the main are:- (i) Alternaria, (ii) Damping off, (iii) Root rots, (iv) Botrytis blight, (v) Mildew, and (vi) Root galls.

Disease prevention: Following are the

measures to prevent and control the diseases.

- Slightly sloppy land with good draining facility should be selected.
- Ginseng thrives well at sites with very good air circulation and low humidity.
- Site should be free from root-knot nematodes.
- Seeds should be properly sterilized and pretreated to prevent from seed-borne disease.
- Use proper spacing and avoid over crowding in the beds. Very dense planting results in quick spread of diseases.
- Remove and destroy diseased plants immediately as soon as the symptoms are noticed.
- It is better to plant ginseng in several small pockets than at one large consolidated plantation. This will prevent spread of disease and loss of entire crop.
- It is better to rotate the crop and select a new site for ginseng cultivation, so that any infestation in the previous ginseng growing site is avoided.

POST HARVEST HANDLING

Seed collection and processing: The ginseng plants flower in its third year of growth. The berries ripen in September, when they turn into bright red colour. Since ginseng is propagated by seed, the ensured indigenous seed production should be the first priority for any effort to domesticate the crop in Himachal Pradesh. Farmers are advised to keep some stands exclusively for seed production. Under ideal growth conditions, a yield of about 400-500 kg/ ha fresh seeds is achieved in traditional ginseng growing countries. The maturity of seeds is asynchronous. The berries in the outer circle mature first by bright red colour. The collected berries are mashed to rupture the skins and placed in a water bucket. The bucket is covered and placed in

shade for 4-5 days, stirring daily until the pulp has disintegrated. The seeds can now be washed through an appropriate sieve or mesh using a pressure hose. The washed seeds are then put again into bucket containing clean water and allowed to settle for about 1 minute to remove the floaters and remaining pulp, if any. The seeds are then surface dried in shade for a few hours to avoid their sticking together.

Seed stratification and storage: The seeds of *P. ginseng* do not germinate immediately after harvest as the embryos are both physiologically and morphologically immature and require a period of 1 to 2 years to mature after harvest under cold moist stratification. Since the seeds are recalcitrant type, care is taken such that the seeds do not lose moisture after harvest and are placed or stored for low temperature stratification. The seeds are subjected to long period of storage in moist medium, preferably in sand or peat moss. The seeds should be thoroughly washed and surface sterilized with 4 % calcium hypochlorite for 10 minutes and then treated with Bavistin (0.2 %) for 10 minutes before storage or stratification. The surface sterilized seeds are mixed with sterile moist peat moss or fine coco peat (1:2), and this mixture is then placed

in-between two layers of sterile peat moss in a clean pot. The pots are then sealed with cling film and stored for stratification at alternating temperatures of 4° C (cold stratification) and 15° C (warm stratification) for about 90 days each, till cracking of the seeds start. The seed germination is asynchronous. Most of the seeds will germinate after 12-18 months of storage. As soon as the seeds start cracking, seeds need to be immediately transferred to field. It is unsafe to delay the seeding of cracked seeds and should be done before the actual germination begins. At present, the initial process of cold and warm stratification is being completed, in the laboratory condition at CSIR-IHBT and depending upon the seed quality cracking may start as early as 6 months of stratification protocols. The cracked seeds are then transferred to field at Lahaul or to any temperate location suitable for ginseng cultivation.

However, under farm practices only cold stratification is adopted. The seeds are mixed with 3 mm mesh screened moist sand (seed 1: sand 2). The mixture is placed in a wooden box 20- 30 cm deep, having a mesh wire bottom and a removable screen lid at the top. The container is filled with the seed and sand mixture. The wooden container is placed under soil cover in a well drained shady area. The screened bottom and top allow for aeration and drainage of excessive water besides protecting the seeds from rodents. The box is covered with about 5 cm of soil at the top. The box is allowed to lay buried in the winter and opened for inspection in early spring. The container should be checked for any decay and if necessary, removal of suspected seeds. Even many times one can find some seeds germinating or cracking. These seeds are sorted out and planted immediately in the beds. The remaining seeds are again aerated, moistened and buried in the container. The box is periodically checked a few times during the year, and the cracked seeds are sown in the beds. The cracking of



Ginseng seed germination after controlled stratification in peat moss under laboratory conditions



Ginseng berries

seeds is quicker in cold and warm stratification than the only natural cold stratification.

Root harvesting and drying: Roots can be harvested by fifth year onwards in the artificially shaded commercial fields depending upon the growth of plants. Harvesting may be delayed in naturally shaded plantings where the growth is normally slow due to competition and little control on soil profile. The harvesting is done only after the berries get ripened and senescence of leaves sets in. The digging of roots is done a few days after the removal of mulch, aerial parts and the artificial shade net, to facilitate the drying of soil and digging up roots with minimal damage. The roots are collected in baskets and washed carefully with clean water without scrubbing or damaging



Mature ginseng plant

the skin. The roots are dried in a room or drying cabinet under dry hot air stream at 35°C after spreading them in a single layer preferably on a wire mesh. A room heater and a fan can be used for room drying. The roots should be dried gradually over 3-4 weeks' time to maintain quality of the roots. The average moisture content of dried roots is about 10 %. The drying process is complete when the roots break with a snap and can be stored for sale. The average yield of roots varies between 2, 500- 4, 000 kg in the ginseng growing countries.

Storage: The dried roots are carefully stored in cardboard boxes. Air tight boxes or plastic bags are avoided as they promote the growth of molds and decay of roots. The roots are stored in a cool and dry place till use or marketing.

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