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Growing rich dietary nuts in Himalayas

The nuts like chestnut and hazelnut are rich in the dietary vitamins and minerals. They can be grown in the temperate region of the Himalayas. Since they are not grown in India on such a large scale due to inadequate knowledge about the nutritional benefits of these nuts, it is required to make the farmers of Himalayan region of India aware of the usefulness of these nuts. The areas of Uttarakhand, Himachal Pradesh and North East regions have good climatic conditions required for growing these nuts. Therefore, these nuts can be explored in such areas of India in order to improve the diversity in nuts production in these regions and also to increase the nutritional benefits to the people.

CHESTNUTS

THE chestnut group is a genus (*Castanea*) of eight or nine species of deciduous trees and shrubs of the family Fagaceae, native to temperate regions of the Northern Hemisphere. The four main species are commonly known as European, Chinese, Japanese and American chestnuts, some species called *chinkapin* or *chinquapin*. The trees are growing in temperate climate of the world for more than 4000 years for beauty, fuel and shelter. Sweet chestnut (*Castanea sativa*) is the only European species of chestnut, which was successfully introduced to the Himalayas and other temperate parts of Asia. There is no organized plantation of chestnut in India, only stray plantation exists and some plants grow wild in the forest of Himachal Pradesh, Uttarakhand, Darjeeling and Khasi hills. Locally the fruits / nuts are called as *Paangar* in this region of Uttarakhand. The performance of these trees is good under the region where the elevation is around 2000 m a.s.l. and the average temperature is around about 7°C during winters with moderate summers.

Chestnut tree

Tree bearing chestnuts

The tree is huge sized and can go up to about 25-30 m in height. Flowers produced are of catkins, borne on current season shoots near the terminal portion of the shoot. The fruit is borne in spiny involucres known as bur. The chestnut fruit has a pointed end with a small tuft at its tip and at the other end, a hilum which is a pale brown attachment scar. In many varieties, the fruit is flattened on one or two sides. It has two skins. The first one is a hard, shiny, brown outer hull or husk, called the pericarpus or peel. Underneath the pericarpus is another thinner skin, called the pellicle or episperm. The fruit inside these shows two cotyledons with a creamy white flesh throughout except in some varieties which show only one cotyledon, and whose episperm is only slightly or not intruded at all.

Nutrition: The sweet chestnut is nutritious, low in fat and rich in vitamin B. A raw peeled chestnut is a rich source of energy, proteins, vitamins and minerals. The nutritional value per 100 g is given here.

Splitted spiny husk with nuts inside

Edible nut after removal of the pellicle

Table 1. Nutritional value of chestnuts (per 100g)

Energy	**200 kcal**
Carbohydrates	44 g
Sugars	11 g
Fats	1.6 g
Proteins	1.6 g
Vitamin B1 (Thiamine)	0.144 mg (13%)
Vitamin B2 (Riboflavin)	0.016 mg (1%)
Vitamin B3 (Niacin)	1.102 mg (7%)
Vitamin B6	0.352 mg (27%)
Vitamin B9 (Folate)	58 µg (15%)
Vitamin C	40.2 mg (48%)
Calcium	19 mg (2%)
Iron	0.94 mg (2%)
Magnesium	30 mg (8%)
Phosphorus	38 mg (5%)
Potassium	484 mg (10%)
Sodium	2 mg
Zinc	0.49 mg

(µg, micrograms; mg, milligrams)

Fresh chestnut fruits have about 180 calories per 100 g of edible parts, which is much lower than walnuts, almonds, other nuts and dried fruits (about 600 kcal/100 g). Chestnuts contain no cholesterol and contain very little fat, mostly unsaturated and no gluten. They have twice as much starch as the potato. In addition, chestnuts contain about 8% of various sugars, mainly sucrose, glucose, fructose and in less amount, stachyose and raffinose. They are the only nuts that contain vitamin C, with about 40 mg per 100 g of raw product. Tannin is contained in the bark as well as in the wood, leaves and seed husks. The husks contain 10–13% tannin.

Cultivation: Chestnut is as hardy as peach and can withstand a low temperature of about -29°C in deep dormancy. Trees can be found at an altitude more than 1500 m a.s.l. Seeds germinate in late winter or early spring, but the life length is short. It is better to sow them as soon as ripe, either in cold frames or seedbeds outdoors, where they can be left *in situ* for 1 to 2 years before being planted in their permanent positions. The planting is done during winters. Before planting, the site should be properly laid out with contour or terrace systems. The pit should be prepared well in advance and refilled with soil mixed with 60 kg well rotten FYM. Plants should be spaced about 30 feet apart as trees are very large in canopy. Chestnut is wind and insect pollinated and is considered self-sterile, so at least two or more cultivars are needed to ensure cross pollination.

Soil requirement: *Castanea* grows best in a soil with good drainage and adequate moisture. The tree prefers sloping and deep soils and does not like shallow or heavy soils with impermeable clay sub-soils. Although *Castanea* can grow in very acid soil, the preferred range is from *p*H 5.5-6.0. It does not grow well on alkaline soils.

Irrigation: Well established trees can withstand a moderate amount of drought. Chestnut is generally grown under rainfed conditions but needs adequate moisture for at least 2 months after blooming. Irrigation at fortnightly intervals after blooming is desirable for better fruit size, yield and nut quality.

Maturity, harvest and yield: The chestnut mature in first fortnight of October in Himachal and Uttarakhand conditions. The bur colour changes from green to light brownish and split open during maturity releasing the nuts. Chestnut is a very perishable crop that requires prompt harvesting at every third day. Traditionally, chestnuts are hand gathered from ground after falling naturally.

The harvested chestnuts are treated with fungicides to prevent spoilage. These nuts are then cured for 5 days at 21°C. The harvest period of each tree is 23 days as maturity is not uniform in chestnuts. Traditionally in the regions of Uttarakhand, a heap of nuts is made when stored and the nuts are taken out from the spiny husk by beating the nuts with a wooden stick. The fully matured nuts come out of the spiny husk immediately which is then separated and nuts are stored. Seedling trees of 12 years

Hazelnut tree

Hazelnut fruits on tree

of age yield about 26 kg of nuts on an average.

Preservation: Besides consuming fresh, chestnuts can also be canned, pureed or preserved in sugar or syrup. Shelled and cooked nuts should be covered, refrigerated and used within three to four days. Cooked chestnuts whole, chopped or pureed, may be frozen in an airtight container and kept up to 9 months. Because of their high water content, transpiration rates and consequent loss in weight, the nuts are used as fresh fruits. They should be kept cool at all times, including in shops when on display for sale. To preserve their freshness for a few months with no artificial refrigeration, the chestnuts can be soaked in cold water for about 20 hours immediately after harvest, after which they are dried in the shade, then layered in dry sand.

Culinary: The fruits can be peeled and eaten raw, but it can be somewhat astringent, especially if the pellicle is not removed. Another method of eating the fruit involves roasting or boiling, which does not require peeling. Once cooked, its texture is slightly similar to that of a baked or boiled potato, with a delicate sweet and nutty flavour. This method of preparation is popular in Uttarakhand. Chestnuts can be dried and milled into flour, which can then be used to prepare breads, cakes, pastas or used as thickener for soups and sauces. They can be used to stuff vegetables, poultry, fowl and other edibles. They are available fresh, dried, ground or canned (whole or in puree). A fine granular sugar can be obtained from the fermentation of the juice as well as a beer; the roasted fruit provides a coffee substitute.

Timber: Chestnut is of the same family as oak and likewise its wood contains many tannins. This renders the wood very durable, gives it excellent natural outdoor resistance and saves the need for other protection treatment. Chestnut timber is decorative.

Economics of cultivation: Production costs vary greatly depending on the growing site and the management practices used. Assuming a wholesale price of ₹500-600/kg. for large-sized chestnuts, the gross return to growers would be ₹6000/ acre per year. The yield at full commercial maturity, 14 – 36 kg of nuts per tree, would project positive cash flow 10 to 15 years after planting if land costs are not too high. The length of productive commercial life of trees can be over 100 years. Net income and benefit: cost ratio of a crop is a deciding factor for its adaptation by the farmers for its commercial production. The benefit: cost ratio of chestnut was recorded under the commercial production as 4.96:1.

HAZELNUTS OR FILBERTS

Hazelnut *(Corylus avellana* L.) belongs to the family Betulaceae and is typically a temperate zone nut crop and mostly grown in Turkey, Italy, Spain, Germany, France and England. The common hazel (*Corylus avellana)* is native to Europe and Western Asia. The chilling requirement of hazelnut is about the same as that of most commercial cultivars of apple and thus it can be grown successfully in the apple growing regions of Himachal Pradesh, Jammu and Kashmir, Uttarakhand and North-Eastern Himalayan regions of India. In Himachal Pradesh, it is found growing wild in Pangi region of Chamba district and locally known as Thangi. In Uttarakhand, the nuts are locally known as *Bhotia badaam.* It bears fruit laterally and terminally on wood of the previous season's growth. A hazelnut is the nut of the hazel and is also known as cobnut or filbert nut according to species. A cob is roughly spherical to oval, about 15–25 mm long and 10–15 mm in diameter, with an outer fibrous husk surrounding a smooth shell. A filbert is more elongated, being about twice as long as it is round.

Nutrition: Hazelnuts have a significant place among the types of dried nuts in terms of nutrition and health because of the composition of fats (primarily oleic acid), protein, carbohydrates, vitamin E, minerals, dietary fibre, phytosterol (beta-sitosterol) and antioxidant phenolics such as flavan-3-ols. Moreover, they contain

Table 2. Nutrutional value of hazelnuts (per 100g)

Energy	628 kcal
Carbohydrates	16.7 g
Starch	0.48 g
Sugars	4.34 g
Dietary fiber	11 g
Fat	60.75 g
Protein	14.95 g
Vitamin A	20 IU
Vitamin B1 (Thiamine)	0.643 mg (56%)
Vitamin B2 (Riboflavin)	0.113 mg (9%)
Vitamin B3 (Niacin)	1.8 mg (12%)
Vitamin B5 (Pantothenic Acid)	0.918 mg (18%)
Vitamin B6	0.563 mg (43%)
Vitamin B9 (Folate)	113 µg (28%)
Vitamin C	6.3 mg (8%)
Vitamin K	14.2 µg (14%)
Calcium	114 mg (11%)
Iron	4.7 mg (36%)
Magnesium	163 mg (46%)
Phosphorus	290 mg (41%)
Potassium	680 mg (14%)
Zinc	2.45 mg (2%)

(µg, micrograms; mg, milligrams; IU, International Units)

significant amounts of thiamine and vitamin B6 as well as smaller amounts of other B vitamins. The nutritional value per 100 g is given here.

Climate and soil requirement: The hazelnut tree is quite hardy but only produces satisfactory crops under moderate climate conditions. Temperature of -10°C is critical, especially if accompanied by wind, which may kill both pistillate and staminate flowers. Hazelnut is more shallow rooted than most fruit and nut trees and do not tolerate wet soils. However moisture retention in the soil is important since the tree cannot tolerate excessive dry summer heat and hot winds. Soils must be moderately fertile and heavy clay soils should be avoided. Hazels grow well in *p*H ranging from 4.5 to 8.5 but *p*H around 7 is ideal.

Planting and manuring: Planting is usually done during winter months. Tree spacing is highly variable in the different countries, as they depend on the fertility of the soil, rainfall and variety vigour. A planting density of 860 trees/ha is recommended with rows 4 - 5 m apart and 2 - 3 m within row spacing. To ensure adequate pollination it is advisable to plant at least 10% of other varieties. Organic fertilizers like FYM should be applied at around 30 tons/ha if the soil organic matter is below 2 per cent. Where, the soil *p*H is around 5.5, it should be raised to 6.5 by liming but not more than 5 t/ha should be given in a single dressing. Fertilizer application to mature trees should be based on leaf and soil analysis. The fertilizer recommendations for hazelnut is 120 to 150 kg/ha of N, 60 to 70 kg/ha P and 100 kg/ha of K.

Edible hazelnut on removing husk and shell

Harvest and yield: When nuts change from green to brown and the abscission starts, it is the best time of harvesting. The nut falls out of the husk when ripe, about seven to eight months after pollination. Nuts are harvested annually in mid-autumn. As autumn comes to a close, the trees drop their nuts and leaves. Most commercial growers wait for the nuts to drop on their own, rather than use equipment to shake them from the tree. Hazelnut trees reach maximum production between fifteen and twenty years. A five year plant yields on an average 2–2.5 kg nuts per year.

The kernel of the seed is edible and used raw or roasted or ground into a paste. The seed has a thin, dark brown skin, which is sometimes removed before cooking. Hazelnuts are used in confectionery to make praline and also used in combination with chocolate. Hazelnut oil, pressed from hazelnuts, is strongly flavored and used as cooking oil.

Economics of cultivation: Production costs vary greatly depending on the growing site and the management practices used. Assuming a wholesale price of ₹200-300/kg. for large size hazelnuts, the gross return to growers would be ₹125000/ acre per year. The yield at full commercial maturity, 2.5-3.5 kg of nuts per tree, would project positive cash flow 10 to 15 years after planting if land costs are not too high. The length of productive commercial life of trees can be over 100 years. Net income and benefit: cost ratio of a crop is a deciding factor for its adaptation by the farmers for its commercial production. The benefit: cost ratio of hazelnut was recorded under commercial production 3.96:1.

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