

Review Article (Open access)

Celtis australis Linn: A Multipurpose Tree Species in North West Himalaya

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ABSTRACT- *Celtis australis* Linn. (Local names- *Kharik*, *Khrik*, family Ulmaceae) is an indigenous species of the Western Himalaya. It grows well at 500-2500 m asl. *Celtis* is a truly multipurpose tree grown for fodder, fuel, timber and various other uses in or around agricultural fields in rainfed agriculture and plays a vital role in socioeconomic structure of hill people. It can be raised in rainfed agricultural lands, degraded lands, wastelands and could be managed in the form of energy plantation, silvipastoral and agri-horti systems. *C. australis* is a promising multipurpose tree species.

Key words- *Celtis australis*, Indigenous, Multipurpose, North West Himalaya, Socioeconomic

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INTRODUCTION

Celtis australis Linn. (Local names- *Kharik*, *Khrik*, *Roku*, *Batkar*, *Brimji*, and common Nettle, family Ulmaceae) is an indigenous species of the Western Himalaya (Singh *et al.*, 2006), mediterranean region and south-western Asia (Quattrocchi, 2000). It has a fairly wide range of distribution that extends eastward to Nepal and is commonly cultivated in N-W Himalayan region (J&K, H.P. and Uttarakhand) and parts of the North East Hill region. *Celtis australis* shows considerable promise as a multipurpose species in Kumaon (Bisht, 2003) and Garhwal (Singh, 2003) of Uttarakhand. *Celtis* is a truly multipurpose tree grown for fodder, fuel, timber and various other uses in or around agricultural fields in rainfed agriculture and plays a vital role in socioeconomic structure of hill people by supplying highly palatable, nutritious and tannin-free green fodder particularly during the period of scarcity of green fodder to livestock (Yadav and Bisht, 2013). In N-W Himalaya, *C. australis* is usually grown in traditional agroforestry systems for fodder and is a common associate of *Ficus* spp., *Bauhinia* spp., *Albizia* spp., *Cedrus deodara*, *Pinus wallichiana*, *Quercus* spp., *Betula* spp., *Aesculus indica*, etc. It grows well at 500-2500 m asl (Gaur, 1999), at its lower limits it is often found in moist situations near nuala's or springs and rivers, hedges, banks and sandy places (Polunin, 1969).

It can be grown in any reasonably good soil, preferring a good fertile well-drained loamy soil (Chittendon, 1956), on dry gravels and on sandy soils. The trees have deep spreading roots (Chiej, 1984) and are very drought resistant once established (Komarov, 1968 and Huxley, 1992). This species requires mild winters if it is to succeed (Simmons, 1972). *Celtis australis* is an important agroforestry species on a wide range of sites in this region (Gaur, 1999). Its foliage is considered as an ideal fodder (with a protein content of 18.21%) for stall-feeding animals (Negi and Todaria, 1994) and its wood is used as a fuel (Bhatt and Verma, 2002).

Growth Habit

Celtis australis is a fast growing, moderate-sized, deciduous, woody perennial plant which withstands a moderate amount of shade. It can be of 25 m high and 50 cm in diameter, under favorable conditions. Crown is irregular, round, spreading, moderate, fast growing and medium texture. Leaves are alternate, simple, serrate, ovate, bowed, pinnate, reticulate, deciduous and green. Bark smooth, light grey, somewhat warty and a wide, broad, rounded canopy, throughout the year fading to a pale yellow before falling in autumn. Flowers are inconspicuous and not showy. Fruits are tiny, round, fleshy, purple hang in short clusters and are extremely popular among birds and other wildlife. Fruit, twigs, or foliage produces high amount of litter. Trees can be very long-lived, perhaps to 1000 years. Plants in this genus are notably resistant to honey fungus.

Agro-Climatic Conditions

Climate

C. australis is a tree of sub-tropical to temperate climate. It can be grown from below freezing temperature to 380 C. It grows well at 500-2500 m asl (Gaur, 1999). Mean annual rainfall varies between 1200-2500 mm. In

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western Himalaya forests, it grows in association with horse chestnut, maple, birdcherry and oak in moist localities of blue pine and deodar forests. Most of the areas where it grows, experience frost in winter.

Soil: It is tolerant of a wide range of soils, preferring deep loamy silts and clays; it can also survive on shallow, gravelly and rocky sites. It grows well along stream banks, on sloping hillsides and on clay loam soil with sufficient moisture (Luna, 1996). It grows on a variety of soils, but will not withstand impeded drainage; on dry gravelly shallow soils its growth is stunted.

Flowering and Fruiting

Flowering, fruiting and sprouting of new shoots vary considerably with elevation and climatic differences, may also vary from year to year in some localities. The old leaves are shed in December- January, while the young shoots appear from March to April. The small greenish flowers appear with the new leaves and trees at the foothills, start flowering in early March. Those located at higher elevations usually flower late in April (Anon., 1992; Singh, 1982 and Luna, 1996). The fruits are formed rapidly after flowering, and reach full-size by June- July (Troup, 1921). The drupes remain green until September-October, and thereafter turn yellow. The fruits ripen by October–November as dried their color turns black. Seed bearing starts at the age of 15 years old or more. The seed is variable in size and numbers per kilogram ranging from 7,500 to 11,000 or more have been recorded and can be stored in sealed containers up to five years. The sweet drupes are damaged by birds, squirrels, monkeys and rodents and help in dispersal of the seeds, to further propagate *Celtis* in other areas. Meanwhile, the fruits that fall to the ground during winter germinate in March-April. However, in dry and low areas, germination is delayed until July, *i.e.* at the onset of the monsoon season. The mortality of seedlings during summer is fairly high, particularly in the lower, dry areas. High mortality of seedlings is also due to the browsing and trampling of cattle and other grazing animals (Singh, 1982). The seeds and vegetative parts of the plant are used to propagate *Celtis*. In India, a large, blackish or purple kind is called roku on the Sutlej; a smaller yellow or orange kind choku (Brandis, 1874).

Seed Extraction and Storage

Twigs and trash can be removed by screening and fanning and depulping of seeds can be done by wet or dry maceration. The seeds will have to dry for storage, if wet maceration is being used, but not if they are to be planted immediately. After crushing pulp from dried fruits debris can be removed by washing on a screen under water pressure (Bonner, 1974). Removal of pulp may not be absolutely necessary, but it has been reported to improve germination. Dry fruits and cleaned seeds store equally in sealed container at 50 C for 5 years without loss of viability, providing that they are orthodox in storage behavior.

Nursery

Seed sowing of *C. australis* depends on climatic conditions and elevation. Seeds are sown in February-April. Pretreatment involves placing seeds in boiling water after cooling and then soaking for 48 hours. Seeds are sown in lines; distance from line to line 20.0 cm and seed to seed distance 2.5 cm and depth of seed in soil 1.5-2.0 cm is kept (Sagwal, 2003). Beds should be mulched with straw or leaves held in place with bird screens until germination starts. Germination is epigeal. The germination starts within 10 days and continue for one month. After reducing number of plants final distance between plants is kept 5.0 cm. Germination of fresh seed is about 70 %. Irrigation and weeding is done regularly in the beds.

Propagation

Through seed

Seeds sown as soon as it is ripe in a cold frame, then sown in February/March in a greenhouse (Sheat, 1948). Seed dimensions, including length, breadth and weight, vary according to seed source or geographical area. Significant positive correlations were found between seed source elevation and both seed morphological characteristics and seed weight (Singh *et al.*, 2006).). The seed can be stored for up to 5 years (Dirr and Heuser, 1987). Treated seeds *i.e.*, seed treated with hot water, cold-stratified seed and excised embryos, germinate early in comparison to untreated seed. Moreover, seed germination is strongly dependent on temperature (250 C), irrespective of seed source therefore, seed germination of *Celtis* in nurseries starts only after the temperature rises, which usually happens in February-March (Singh *et al.*, 2004). Seedlings become plantable stock in 4-5 months. The seeds of this tree can also directly sow in the pits.

Through cuttings

Stem cuttings of 5-15 cm in length and 1.5-2.0 cm in thickness are used for propagation. The hormonal (IBA) treatment to cuttings is helpful for rooting percentage and number of roots per cutting, furthermore, sprouting percentage and root length may also higher. IBA not only enhanced root formation but also improved the quality of the root system of *Celtis* (Butola and Uniyal, 2005). The vegetative propagation of *Celtis australis* have been published (Shamet *et al.*, 1989; Bhatt and Todaria 1990). Shamet *et al.* (1989) reported that exogenous application of a high (3000 mg/L) concentration of auxins (IBA) enhanced rooting in *C. australis* under mist conditions. The most successful vegetative propagation methods were root cuttings (5 cm long) from juvenile phase (2-yr-old) trees shallowly inserted into a peat-sand medium and side grafts utilizing parafilm wraps and a graft tent. Propagation by cuttings (Bonner, 1974) and grafting and budding success has also been reported (Williams and Hanks, 1976).

Transplanting

Planting out of saplings is done in the pits of 2.0 m X 2.0 m spacing from nursery. Improved pit planting techniques (Bisht *et al.*, 1999) is used for plantation of *Celtis* in hills for better establishment and utilization of degraded slopping lands. The dimensions of pit are 1.0 m diameter and 0.75 m depth, dug out soil was put on the lower half border of the pit and sown with *Desmodium* spp., which will provide forage during initial years and will improve soil fertility. Pits are filled with mixture of compost and soil in 1:2 ratios. Planting out is carried out in December-January (autumn), when seedlings are leafless. In some areas, transplanting is done with the onset of monsoon. Weeding and protection from livestock and fire are essential both in the nursery and after planting. *C. australis* is a light demander and is adversely affected by drought. The tree pollards and coppices well.

Management Practices

Seedling growth

In India, it gained maximum shoot and root growth at 61.05 cm and 30.47 cm, respectively, regardless of variations in seed source in nursery. However, Gairola *et al.*, (1990) reported that *Celtis* seedlings attained maximum (129 cm) height after a year. The average collar diameter of the seedlings was recorded 5.85 mm in the nursery for one year. Among the various seed and seedling parameters, seed weight, shoot length, shoot weight, number of branches and seedling weight exhibit high heritability and genetic gain. These characteristics must thus be considered in selecting plants that are most suitable as planting stock (Singh, 2004).



Fig. 1: *Celtis australis* under different management practices

Energy plantation

In energy plantation systems, particularly or relatively faster growing trees are raised in a close spacing for production of higher biomass from per unit area. *Celtis australis* has been found quite promising for the coppice farming in the form of energy plantation (Bisht, 2003) and could provide scarce products of forage, fire wood and ecological infrastructure for sustained yield. The forage yield varies from 150-200 q/ha during third year and 400-650 q/ha green matter in the subsequent years.

Silvipastoral system

In hills, marginal and sub-marginal lands can be utilized by adopting silvipastoral system of forage production. *Celtis australis* on degraded land at 5 m X 2 m spacing can yield 18-25 t/ha/year with *Digataria decumbence* and *Quercus leucotrichophora* in Silvipastoral system (Bisht and Gupta, 2000).

Silvi-horti system

Celtis australis can be managed in silvi-horti system, to increase the fodder production. In a study conducted at VPKAS Almora, ginger (*Gingerbar officinale*) and turmeric (*Curcuma longa*) were grown under ten year old *Celtis australis* fodder trees. Green forage yield varied from 5.7 to 7.7 kg/tree (Bisht *et al.*, 2000).

Nutritive Content of Foliage

The chemical composition of *Celtis* foliage has seasonal as well as altitudinal variations. Between seasons 91.7-169.7 mg/g crude protein, 0.77 1.63 mg/g phosphorus, 2.84-7.57 mg/g potassium, 139.3- 198.0 mg/g crude fiber, 11.12- 18.29 mg/g sugar and 47.90- 65.26 mg/g starch. Foliage from high altitudes exhibits higher nutrient levels as compared to those located at the lower areas (Singh and Bhatt 2009). The Chemical composition of leaves on dry matter basis dry matter 32.60%, Organic matter 88.0%, Crude protein 15.23%, Ether extract 2.55%, Crude fiber 16.90%, ash content 12.0%, Cellulose 24.4%, Hemicellulose 7.62% and digestibility on dry matter basis DMD 65.20%, OMD 66.30%, CPD 65.22%, CFD 55.23% reported by Pandey *et al.*, (2006).

Uses

Fodder- The *Celtis* tree is mainly grown for fodder. It is lopped during lean periods (October to mid January) and provides ample supply of highly palatable, nutritious, and tannin-free fodder during peak periods (Bisht *et al.*, 2000 and Bisht and Yadav, 2015).

Timber- The timber quality of *C. australis* is excellent. It is used in making tools and whip handles, cups, spoons, churners, sports goods, oars, canoes, sticks and agricultural implements. It can also be carved, used to construct carriages, and as a general building material (Bhatt and Verma, 2002). Its wood is also used as fuel wood. It contains 16.81 KJ/g calorific value, 0.54 g/cc density, 3.4 percent ash, 57.53 percent moisture, 0.40 percent nitrogen, with a Fuel wood Value Index of 464

(Purohit and Nautiyal, 1987). The timber of *Celtis* is also reportedly a good source of paper and pulp (Pearson and Brown, 1932 and Trotter, 1944).

Medicinal- The fruits are used as remedies for amenorrhea, colic, heavy menstrual and intermenstrual bleeding (Duke and Ayensu, 1985 and Chopra et. al., 1986). The stems and leaves are crushed, and given to those afflicted with leprosy by the Bhil tribe of Madhya Pradesh (Maheshwari *et al.*, 1986). The tribes of the Western Himalayas boil the roots and use them as remedies for colic and other stomach troubles (Karnick and Pathak, 1982 and Chevallier, 1996). The bark is also made into paste and applied on bones, pimples, contusions, sprains and joint pains (Gaur, 1999). The decoction can also be used to astringe the mucous membranes in the treatment of diarrhea, dysentery and peptic ulcers (Chevallier, 1996).

Edible- Fruits raw (Simmons, 1972 and Chiej, 1984), small and insipidly sweet (Hedrick, 1972). Seed raw or cooked (Chiej, 1984 and Uphoff, 1968), oil is obtained from the seed (Chiej, 1984).

Others- A yellow dye is obtained from the bark (Polunin, 1969), wood very tough, pliable, durable (Uphoff, 1968; Usher, 1974 and Gupta, 1945). Widely used by turners (Chiej, 1984), for the handles of agricultural implements (Manandhar, 2002). The flexible thin shoots are used as walking sticks (Usher, 1974) and an excellent fuel (Gamble, 1972).

CONCLUSIONS

Celtis australis not only provides nutritious fodder to the livestock in N W Himalaya, particularly during peak periods, but also fuel wood and small timber for the poor farmers, among other uses. Leaves can play an important role in mitigating the shortage of protein in the diet of animals. *Celtis* seeds from higher altitude areas are better for mass propagation and plantation. It can be raised in rainfed agricultural lands, degraded lands, wastelands and could be harvested twice a year. It is managed in the form of energy plantation, silvipastoral and agri-horti systems. Seed weight and shoot growth should be the characteristics considered for raising quality planting stock of *C. australis*. *Celtis* is a promising tree for integrating in agroforestry systems.

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