

Khair (*Acacia catechu*)

Knowing the Species

(a) Introduction

Acacia catechu is a deciduous tree with a light feathery crown and dark brown, glabrous, slender, thorny, shining branchlets, usually crooked. Bark dark brown or dark grey, brown or red inside, nearly 12-15 mm in thickness, rough, exfoliating in long narrow rectangular flakes which often remain hanging. Blaze very hard, colour brown and then deep pink.

Branchlets armed with pseudo-stipular spines in pairs below the petioles. Pod 10-15 cm by 2-3 cm, thin, straight, flat, glabrous dark-brown and shining when mature. Seeds 3-8, about 5 mm in diameter.

(b) Natural Habitat and Classification

Acacia catechu is widely distributed throughout the greater part of India except the most humid, cold and the driest regions. It is common in the sub-Himalayan tract and outer Himalayas ascending from 900 to 1,200 m from Jammu to Assam. The record distribution of khair shows that the various forms of it, rather than overlapping, appear representative of none or another tolerably well defined areas.

Var. catechu – Found chiefly in Punjab, Garhwal and Kumaon, Bihar and Orissa. In the sub-Himalayan tract and the outer Himalayas, it ascends upto 900-1200 m elevation.

Var. catechuoides – Found chiefly in Sikkim terai, West Bengal and Assam. This is the Burmese form.

Var. sundra – Found chiefly in the Indian Peninsula. This is southern and western form occurring in the Deccan, Maharashtra, Gujarat and Rajasthan.

Thus the var. catechu has never been found in Eastern Himalayas nor in Assam. The var. catechuoides is apparently absent from the Western peninsula. The var. sundra which is now given specific rank *Acacia chundra*, is confined to Deccan, Gujarat, Rajasthan, Southern Maharashtra only.

Classification

Acacia catechu occurs in tropical moist deciduous forests, dry tropical forests and tropical thorn forests in the following sub-types as given by Champion and Seth (1968).

- In low alluvial savannah wood land (3/1S1) associated with *Bombax ceiba*, *Butea monosperma*, *Dalbergia sissoo*, etc.
- In Southern tropical dry deciduous forests (5 A), Khair occurs in very dry teak forests (5 A/C1a) and dry teak forest (5A/C1b), associated with associates of teak. It also occurs in southern dry mixed deciduous forests (5A/C3). Common associates are *Terminalia alata*, *Boswellia serrata*, *Azadirachta indica* etc.
- In northern tropical dry deciduous forest (5B), khair occurs in dry sal bearing forests (5B/C1), dry Siwalik sal forest (5B/C1a), dry peninsular sal forests (5B/C1c) and

northern dry mixed deciduous forests (5B/C2). Common associates are *Shorea robusta*, *Terminalia alata*, *Terminalia bellirica*, *Boswellia serrata*, etc.

- Khair occurs in dry deciduous scrub (5/DS1), associated with *Nyctanthes arbortristis*, *Dodonaea viscosa*, *Woodfordia fruticosa*, *Carissa opaca*, *Flacourtia indica*, *Lannea coromandelica* etc.
- It occurs in edaphic climax types of dry deciduous forests as in Anogeissus forest (5/E1) m and Aegle forest (5/E6).
- It is also found in the seral type of dry deciduous forests as in Khair-Sisam forests (5/1S2).

In southern tropical thorn forests (6A/C1), *Acacia catechu* occurs associated with *Acacia leucophloea*, *Anogeissus latifolia*, *Azadirachta indica*, etc.

Climate

In the natural habitat of khair, the absolute maximum shade temperature varies from 40°C to 50°C and the absolute minimum from 2.5°C to 7.5°C. The mean daily maximum temperature in May which is generally the hottest month in the hot weather varies from 37.5°C to 43.5°C. The mean daily minimum temperature in January which is the coldest month of the year varies from 1.0°C to 2.1°C.

Acacia catechu is essentially a tree of comparatively dry regions though in its alluvial form, it extends into regions of heavy rainfall as in the Eastern sub-Himalayan tract, where it is found in places with rainfall as high as 3,800 mm. Away from riverain tracts it occurs in localities where the normal rainfall varies from 500 to 2160 mm. Khair develops to its maximum size in localities with heavy rainfall but it is decidedly xerophilous and grows in dry situations where few other species survive.

Topography

It is found on flat or gently undulating ground and ravine country as well as in hilly region but seldom extends in areas above 1200 m in elevation above the sea level.

Geology and soil

Khair occurs on a variety of geological formations and soil, though it undoubtedly thrives best on porous alluvium, composed of sand and shingle and on well drained sandstone. It is known to occur on granite, gneiss, schist, quartzite, shale, basalt, limestone, conglomerate and laterite.

(c) Growth Characteristics

A small or medium sized deciduous tree 12-15 m in height. More commonly found as a small tree 60-90 cm in girth and a bole of 2 to 3 metres. When growing in more favourable localities, it has a moderately straight and cylindrical stem up to 240 cm in girth and 30 m in height.

(d) As a Plantation Tree

On account of its hardness and value of wood, khair is an ideal species for the conversion of miscellaneous forests, containing inferior species and is being used to a considerable extent for afforestation in Uttar Pradesh. It plays an important part in the afforestation schemes of ravine lands of the drier parts of U.P. Experiments carried out to investigate the possibility of afforesting usar land with well defined kankar pan in U.P. indicate that the species is moderately suitable in mild usar, if planting is done in deep pits filled with better soil.

Utilization of the Species

(a) Properties Including Strength Properties

Physical properties of the wood

Sapwood sharply distinct from heartwood, light yellowish-white or yellow. Heartwood deep red or reddish brown, darkening on exposure; somewhat lustrous. The wood is hard to very hard, heavy to very heavy, average weight 1010 kg/m^3 at 12% moisture content; somewhat coarse and even-textured and straight to interlocked grained. The wood has no characteristic smell or taste.

Mechanical properties

The timber is very strong, very hard, very steady and moderately tough. The figures for its suitability as a timber for various purposes, expressed as percentages of the same properties of teak, for specimens from western U.P., are – weight, 147; strength as a beam, 128; stiffness as beam, 119; suitability as a post or strut, 127; shock resisting ability, 111; retention of shape, 116; shear, 155; surface hardness, 178; refractoriness (splitting co-efficient), 100; nail or screw holding property, 148.

Seasoning properties

The timber is highly refractory and liable to end-splitting and surface cracking during seasoning. It seasons very slowly. It should therefore, be converted soon after the rains and stacked properly under shade, well protected from rapid drying. Seasoning of thick boards or planks should be avoided wherever the timber is intended to be further converted into thinner sections.

The best results in kiln drying with this timber will be obtained by using schedule No.II for 2.5 cm thick planks and suitably increased humidities at the various moisture content steps in the schedule in case of thicker sections. Wherever practicable, slow partial air-seasoning to about 25% moisture content before finally taking up kiln seasoning should be attempted. The pith should be removed from the pieces before seasoning.

The sapwood is not durable. The heartwood is very durable and is described by Pearson as “one of the most durable Indian woods, which is seldom, if ever, attacked by white ants and fungi”. There are several records of its having lasted for centuries in temples and it has also done well in harbour works. Natural durability ‘graveyard’ tests carried out at the F.R.I., Dehra Dun, have shown an average life of over 20 years.

Working qualities

The timber is hard to saw and machine, especially if the wood is old and dry after seasoning. A heavy gauge plate saw with closely spaced teeth and shallow gullets gives the best results and stiff tools should be used in machining and turning. The timber can be turned well. The wood can, however, be finished to an extremely smooth surface and takes polish well.

(b) Use as Timber, Poles, Pulp and Paper, etc.

Though Khair is chiefly used as a source of katha and kutch, it is also a useful timber. It is much prized for posts in house construction and also for making rice pestles, oil and sugar-cane crushers, ploughs, tent-pegs, sword handles and keels and knees of boats. There is, however, a local superstition against it in parts of Uttar Pradesh on account of which it is not used in house construction.

Khair is a valuable economic structural timber, the heartwood being naturally durable. This species has been classified as "Super Group" timber suitable for large spans more than 12 m and is placed as the first choice of selection for permanent structures (I.S.I., 1962). It is eminently suitable for tools and tool handles, particularly for mallets and plane bodies. It is excellent for making spokes and hubs of wheels.

Sapwood of khair is a waste product in katha industry as it does not find at present any use except as a fuel. Since the katha manufacturers use the spent heartwood chips as a fuel in their boilers and bhattis, considerable quantity of the sapwood is literally wasted.

It can be seen from the results of chemical composition of the wood obtained at the F.R.I. Dehra Dun, that the sapwood of khair trees, if collected economically, can be profitably utilized for producing bleached cellulose which will find use in multifarious cellulose based industries like CMC, cellulose acetate, ethers, and even for paper and paper boards if made available in large quantities.

(c) Use as Fodder

It is considered to be a good fodder tree and is extensively lopped to feed goats and at times cattle also. The plants are also browsed by cattle, rhinoceros, deer and elephant. The leaves contain 13.03-18.72% crude protein, 46.69-50.96%N free extract and 0.14-0.17% phosphorus. Total digestible nutrients are 46.33 kg. of dry material. The nutritive ratio is 15.0. The digestibility values are moderately high which shows that the leaves are feed for cattle on the basis of crude protein, crude fibre and tannin contents. The leaf fodder *Acacia catechu* is rated as good.

(d) Use as Fuel

It is also used as fuel and furnishes charcoal of good quality, the calorific value of moisture free sapwood being 5142 calories (9256 B.T.U.) and that of heartwood 4946 calories (8915 B.T.U.).

(e) Medicinal Uses

The different parts of the tree have a variety of medicinal uses, which in haemoptysis (spitting of blood). A paste of the bark is useful in conjunctivitis. The bark is reported to be useful in the treatment of snake bites.

Flowers: A mixture of flower tops, cumic, milk and sugar is useful in gonorrhoea.

Wood: Cutch and katha obtained from the heartwood have great medicinal value. It is cooling, digestive and a very valuable astringent, specially in chronic diarrhoea and dysentery, bleeding piles, uterine haemorrhages, leucorrhoea, gleet, atonic dyspepsia, chronic bronchitis, etc. It is also useful in cases of mercurial salivation, bleeding or

ulcerated or spongy gums, hypertrophy of the tonsils, relaxation of the uvula, aphthous ulceration of the month, etc.

A mixture of catechu and myrrh (Kathol) is usually prescribed as a tonic and as a galactagogue to women after confinement.

Kheersal is used as a remedy for chest diseases, especially for the treatment of asthma, cough and sore throat.

(f) Katha (Catechu)

The most important product obtained from *Acacia catechu* var. *catechu* proper is katha or catechu. This is obtained by boiling chips of heartwood with water. In India two varieties are marketed katha or pale catechu and cutch or dark catechu. As sold in the bazaar, katha is found in irregular pieces or small square blocks of grayish colour, which on breaking show a crystalline fracture.

There is a very large internal demand for it for masticatory use in pan preparations and in medicine. Katha is regarded as astringent, cooling and digestive and is useful in sore throat, cough and diarrhea. Externally it is employed as an astringent and as cooling application to ulcers, boils and eruptions on the skin. It is an indispensable ingredient of pan preparations. In combination with lime, it gives the characteristic red colouration resulting from the chewing of pan.

Dark catechu or cutch, which is mainly obtained as a by-product of the katha industry is marketed in the form of small cubes or blocks, rusty brown or dull orange in colour and of conchoidal fracture. It is used only for industrial purposes. It is largely used for dyeing cotton and silk and preserving of fishing nets, sailing ropes and mail bags; in water softening and in the manufacture of stencils and printers ink.

(g) Other Uses

Tanning: The astringent bark is sometimes used for tanning.

Lac: Khair is a very good host plant for growing the Katki or Aghani crop in alternation with the normal Rangeeni or Kusumi hosts. This species is unsuitable for the Baisakhi or fethwi crops due to non-possession of sufficient vitality during the late winter and early hot weather months to bear a lac crop. This species is best used for raising the Aghani crop and produces an encrustation equal in quality and quantity to that produced on kusum (*Schleichera oleosa*). The brood from the infestation of khair with kusum brood takes very well when used to infect kusum again in January-February. The resulting lac is of good quality.

Gum: The gum from khair is said to be of very good quality and is regarded as the best substitute for true gum arabic. The tears may be as large as 3 cm in diameter and pale yellow to dark amber in colour. It is not collected separately and is generally mixed up with other *Acacia* gums.

Under natural conditions, the seed is disseminated by wind. The seeds adhere to the light pod valves after the pods dehisce and are often blown to a considerable distance from the trees. In alluvial tracts, dissemination of the seed is further effected by water. Though the seed itself is rather heavy, the pod with seeds get washed down and the seeds rubbed off among the sand and boulders of newly thrown up islands and banks.

Germination takes place in the beginning of the rainy season and the early development of the seedling is greatly favoured on loose soil free from weeds. Thus on alluvial sand or gravel, countless number of small seedlings may be found in the early part of the rainy season not only in the open but also under a comparatively dense cover. In the latter case they die rapidly owing mainly to shade and to damping off and by the end of the season, most of the seedlings disappear. In the open, a fair proportion survives provided the seedlings are protected from grazing.

The cattle are very fond of young shoots and closure of areas under regeneration has strikingly beneficial results. Frequently, there is a high mortality from drought, particularly if the soil is stiff or shallow and the roots have difficulty in penetrating it. The seed germinates readily with heavy rain and although germination takes place ordinarily at the commencement of the monsoon, it may begin earlier in the season in case of early heavy showers of rain; when this happens the seedlings generally die off or the germinating seed perishes in the ensuing spell of dry weather. Such mortality is particularly marked in the case of seeds germinating on the surface of the ground.

In wet and sodden grass, however, the seedlings damp off. Khair seed is very delicate and is at once killed by the slightest damage from fire. As the seed falls in January and February, that is to say, just before the fire season commences, fires must be rigidly kept out from the areas under natural regeneration. The slightest carelessness in this respect may jeopardise a whole year's natural regeneration.

The freedom with which natural reproduction of khair springs up in alluvial riverain tracts is remarkable. The chief factors favouring it in such localities are the new loose soil free from heavy weeds and the abundance of light while the soil moisture obtained by percolation no doubt also assists the development of the seedlings.

As the crops become older and elevated above the river bed through changes in the course of the river, the conditions for natural regeneration change. The ground becomes harder and a dense undergrowth of *Adhatoda vasica* or other plants frequently makes its appearance. Under such conditions, natural reproduction is no longer possible and although it continues to take place where new alluvium is thrown up, it ceases under the old crops.

Nursery Practices

(a) Nursery Site

Nursery work presents little difficulty, provided the nursery site fulfills the basic conditions of complete overhead light, a sandy loam soil, adequate irrigation and drainage. Soil working may be required especially in the case of heavier soils of the nurseries.

(b) Seed Collection and Storage

As a rule the tree seeds well almost every year and produces abundant crop of pods. The seeds adhere to the light pod valves after the pods dehisce and are often blown to a considerable distance from the trees. Seed fall takes place in the month of January and February. Khair seed is very delicate and is at once killed by the slightest damage from fire.

The seeds can be collected by lopping small pod bearing branches in December or early January and spreading them in the sun for a few days. The pods are then heaped on a gunny bag and beaten with sticks. The pods are separated by shaking and winnowing in a flat basket.

(c) Sowing

It is advisable to sow the seeds in the year in which they are collected. Seeds are sown in the nursery in the month of April or May. Germination commences from about the 4th day after sowing and its completion may linger on upto 36 days. It is better to soak the seeds in cold water for 24 hours before sowing. In West Bengal, the pods are soaked in water for one or two days in May and then sown, there being no need to separate the seed.

(d) Irrigation

Irrigation is essential in the nursery till the out break of monsoon. The seedlings require daily irrigation with a precaution that the water does not accumulate at the roots of the plants.

(d) Weeding

One of the commonest form of mortality in the case of seedlings in a heavy growth of weeds is the damping off to which they are subject during the rains. For optimum growth, nursery should be kept free of weeds as these are liable to kill seedlings by suppression. It is therefore advisable to carryout regular weeding programmes especially in the rainy season.

Planting Practices for the Species

(a) Direct Sowings

Direct sowing gives good results and its very easy. The methods of sowing vary under different conditions. In the grassy savannahs of Avadh, line sowings have proved successful in spite of a fairly tall growth of grass in the rains.

In areas flooded for long periods in the monsoon, Khair should be sown on mounds at least 61 to 76 cm in height so that the seedlings do not remain submerged in water for a long period; a few weeks' submersion is not fatal.

Broadcast sowing has also been frequently tried, often with success: where suppression from weeds is to be feared, however, it cannot be compared with line sowings. The method which has succeeded best and is also very cheap is that of line sowings with or without the raising of agricultural crops and is being adopted in several parts of India.

(b) Taungya Technique

In Uttar Pradesh, large areas of miscellaneous forests of little value have been converted into plantations of valuable species such as *Acacia catechu* by line sowings with rains, weeding and fencing.

The annual coupe is clearfelled, the timber and firewood extracted and the area divided up into plots varying size from 0.4 to 1.6 ha and distributed among the cultivators. The cultivators then prepare the land for sowing, by burning the slash, up rooting the stumps if necessary and working the soil by hoeing or ploughing.

In many places unrestricted cultivation with any field crop is allowed in the first season. In the second season, the ground is prepared for the sowing of the selected tree crop in lines which may be kept 4.6 to 7.6 meters apart and the sowing of this and the field crop is done at the appropriate time. Both the forest crop and the agricultural crop grow up simultaneously and the cultivators undertake to keep the seedlings well weeded and to prevent the field crop from shading and suppressing the seedlings.

Cultivators may continue to take out field crops and tend the seedlings along with them from 1 to 3 years after the introduction of the tree crop, depending upon the fertility of the soil and the rate of growth of the seedlings. In the meanwhile they also get each year freshly cleared areas for sustained working. When the seedlings render taking out of field crop from an area uneconomic, that area is no longer cultivated and left for normal protection by forest staff. This system of cultivation promotes vigorous growth, the thorough working of the soil and the weeding causing the roots to strike deep down from the commencement.

Mechanized plantations

In the mechanized plantations, the annual felling coupes are of several hundred hectares. The standing forest is marked for clear felling and sold by auction, with a stipulation that all the trees are felled by uprooting upto 60 cm depth and all the old stumps as well as the surface roots are dug out by the purchaser. This operation as well as the extraction and removal of all the produce and roots is under sale-deed to be completed in the winter season.

The area so cleared is given a hot burn and is first fully ploughed, then harrowed and finally ridged by tractors, the last operation consisting of laying out 45 cm high parallel ridges spaced 3-4 m apart centre to centre throughout the area. A system of roads and paths is then laid out, dividing the large coupe area into smaller plots of about 20-30 hectares. These plots are leased out for cultivation for 1-2 years, with the condition that the lessee will also look after, weed and tend the forest plants sown or planted along the ridges, together with his own crop.

Khair and other seeds are sown in the ridges in the 3rd week of June. The seed germinates with the out-break of monsoon and seedlings are weeded by the lessee. Three weedings have to be carried out by him in the first year, three in the second year and two in the third year. The area is already fenced in the summer of the first year and remains so till the plantation is about 6 years old.

On the termination of lease the fire protection work is carried out by the forest department by laying out a number of fire lines round the coupe and plots and keeping them clear by cutting and burning the grass in late winter or spring. Sometimes the tall grasses in the intermediate strips between the ridges are hoed down by tractors to reduce their inflammability. The pressed grass may, after the plantation has become high enough, with all precautions, be control-burnt in cold weather.

(c) Root and Shoot Cuttings (Stumps)

Under optimum conditions, Khair can also be propagated by stumps. The stumps should be made from seedlings about 15 months old raised in nurseries from seed sown in April of the previous year and irrigated till the break of monsoon. Cuttings should be made from well developed seedlings. The root and shoot should be 23 to 31 cm and 2.5 to 5.0 cm respectively.

The best size of stumps at the root collar is 10 to 15 mm in diameter. The seedlings under 10 mm in diameter at root collar do not make good cuttings, while seedlings thicker than 15 mm in diameter at root collar do not produce satisfactory shoots or fail to produce shoots. Planting of stumps should be done soon after the break of rains: delayed planting is not advisable. Under irrigated conditions stumps can be planted during March-April.

Entire planting

In recent years entire planting of container plants has been successfully tried, particularly in Gujarat and Rajasthan. Polythene bags of the size 30 x 10 cm are suitable as containers. In Indonesia bamboo tubes have been reported used as containers.

Cultural Operations and Its Calender

(a) Weeding

Repeated weedings are necessary in the first two or three years. Two good weedings are enough but sometimes a third is required in the first rains. One weeding may be necessary in the third year especially round the backward plants. The amount of weeding needed will depend on the site.

(b) Cleaning, Thinning, etc.

Khair seedlings usually come up in a congested crop. In the early cleanings, plants may be spaced about 80 to 120 cm apart. Early thinnings are very important for the proper development of the crop. All shade, even lateral, must be removed. Normally the first thinning should not be delayed beyond the 5th year. If grown pure, it requires repeated climber cuttings. In taungya plantations, like that of North Gonda, the first cleaning is done at the age of 3 years. Subsequently thinnings are done at the ages of 5, 10, 15, 20 and 25 years. The first three thinnings are mechanical, in which a spacing equal to half to average crop height is aimed at.

In coppice crops, it becomes necessary to reduce the number of the several coppice shoots sprouting from a single stump to one or two within 3-5 years.

Pest, Diseases and Deficiencies

Khair seedlings are comparatively resistant to damping off disease in the nurseries, however, water logging may sometimes predispose the seedlings to damping off in the early stage of development.

(a) Root Rot

Ganoderma lucidum (Leyss.) Karst. Causes serious mortality due to root rot in reforested stands. Khair is susceptible to the attack of pathogen at all ages. The affected plants exhibit pale foliage followed by drying. Young plants are killed soon after infection while the mature trees die when most of the roots become affected.

The fungus produces thin white mycelial mat between the bark and wood and causes white spongy rot in the sapwood. Fruit bodies of the fungus develop at the base of affected trees which are stalked and corky. The stalk and upper surface are dark brown, and lightly zoned. Lower surface is white when fresh, turning light brown on drying and covered with minute circular pores. The spores are produced in abundance and are deposited on the adjoining weeds or grass as brown red powdery mass.

The disease can effectively be checked by extraction of old stumps and cleaning of debris from the site, digging of isolation trenches in young plantations, planting of resistant species like

Bombax ceiba and *Ailanthus excelsa* and mixed cropping (50:50) with resistant species.

(b) Heart Rot

Fomes badius Berk. Causes heart rot in Khair and is common in all Khair forests, both natural and planted. Sporophores develop on the branches and trunk and are the main source of identification of diseased trees. They are perennial, hoof-shaped, sessile, hard and woody. Upper surface is brown or black, cracking with age.

Lower surface is dull brown with numerous minute pores. The fungus causes decay in the heart wood only. Sapwood remains healthy and free from infection. Initially the heartwood changes to deep brown in colour, but later becomes yellow, spongy and mottled. The heart rot increased with age of tree and mature trees become unfit for extraction of cutch and katha due to its complete disintegration.

The disease can be managed to some extent by avoiding injuries to the trees and by periodically removing the sporophores from the trees and burying them in the soil.

(c) Other Diseases

Apart from the above, minor diseases, infect the foliage of trees. *Erysiphe acaciae* causes powdery mildew and *Microstromata acaciae* produces snowy-white tufts on the lower surface of *Khair* leaves. Leaf rust by *Ravenelia tandonii* is common in North India. Among phanerogamic parasites *Khair* is attacked by *Macrosolen, cochinchinensis* and in H.P. by *Loranthus sp.*

(d) Pests

Beetles, larvae of borers, defoliators and sap suckers cause severe damage to the young living plants.

Deers, pigs, wild elephants, porcupines, rats and domestic animals also damage young plants.

Growth Yield and Management of the Species

The following statement shows the average rate of growth based on the measurements of 14 sample plots of Saharanpur, Rohilkhand, Ramnagar, Lansdowne, Haldwani, Baharaich and Terai and Bhabar Forest Division of Uttar Pradesh.

Average rate of growth

Age (in years)	Crop Height (in metre)	Crop Diametre (in cms)
10	11.27	12.2
20	16.15	18.8
30	18.59	22.4
40	19.81	25.4
50	20.73	27.7
60	21.34	29.7
70	21.64	31.2

The following table shows the total volume (Over Bark) and total volume (Under Bark) in cubic metres.

D.B.H. (in cms)	Volume (Over Bark) (in cubic metre)	Volume (Under Bark) (in cubic metre)
10	0.13151	0.10084
20	0.18502	0.14195
30	0.49415	0.39836
40	0.86718	0.70860
50	1.26577	1.04037

The following table gives the yield of Khair for good, moderate and poor site qualities. The table is based on the data of 10 sample plots distributed in Haldwani, Terai & Bhabar, Siwalik, Ramnagar, Lansdowne divisions and Silviculture Nursery at Clutterbuckganj (Bareilly).

Age	Dominant		Number of Trees / ha	Total Volume / ha (in cubic metre)
	Height (in m)	Diameter (in cms)		
Good Sites				
10	13.5	23.0	557	9.65
20	18.3	27.0	440	31.31
30	21.1	29.7	349	47.53
40	23.0	31.8	287	59.38
50	24.5	33.4	242	68.48
60	25.6	34.6	208	75.93
Moderate Sites				
10	10.6	21.1	557	3.23
20	15.3	25.4	460	18.00
30	18.1	28.3	376	33.34
40	20.1	30.5	312	45.47
50	21.6	32.2	264	55.12
60	22.8	33.5	227	62.97
Poor Sites				
10	8.0	18.8	557	0.57
20	12.3	23.5	460	8.22
30	15.1	26.5	396	19.89
40	17.1	28.8	336	31.30
50	18.7	30.7	288	40.96
60	19.9	32.2	250	49.25

Market and Marketable Products, Used as Raw Material in Forest Based Industries

In India, State Forest departments are the major producers of Khair wood. The wood is generally disposed off by the respective State Forest Departments/Forest development corporations at their sale depots.

Wholesale markets are mostly located in towns. These are permanent in nature where transaction take place daily throughout the year. In these markets (Mandis) the wholesalers and commission agents play an important role in the sale of produce. During recent years, with the development roads, communication and transport, there has been a marked increase in the sales of Khair wood at these markets (mandis).

In M.P., marked Khair trees are cut in the coupe and if the trees are big then logged into pieces and numbered. Cut Khair wood is transported to depot where it is transferred to one of the following agencies.

- (i) Given to advance purchaser who has tendered the highest rate on log basis for a particular coupe.
- (ii) Given to cooperative societies or cottage industry for making Katha by country method.
- (iii) Supply of Khair wood to Katha factories under contractual obligation.
- (iv) In case of default by any of the above agencies Khair wood is auctioned from the depot.

(a) Khair Wood Used as Raw Material in Katha Industries

About 63,000 tonnes of khair wood (*Acacia catechu*) in India is annually consumed for manufacture of cutch & catechu. Chemically the products are catechin (Katha) and catechutannic acid (cutch). A third article of commerce is also obtained in the shape of a white powder, known as kheersal, which appears as a deposit in the wood. It is used for medicinal purposes specially for cough and sore throat.

(b) Yield of Katha (Cutch)

The yield of katha and cutch varies considerably with the season in which the trees are felled and their girth, age and condition. The maximum yield of katha is obtained from trees felled in autumn and winter. Trees that are gnarled and crooked are reported to give higher yields than straight one. Trees of higher girth having white lines on them are preferred. Freshly felled trees also give higher yields than dried ones. Dead trees are unsuitable for extraction. Following table depicts yield of katha & cutch from 100 kg. of khair heartwood in different parts of the country.

States	Factories		Small scale units	
	Katha	Cutch	Katha	Cutch
Andhra Pradesh	--	--	2	3
Mumbai (Inc.	4.5	12	3-4	10

Maharashtra & Gujarat)				
Madhya Pradesh	1.5-1.7	10-12	3	--
Uttar Pradesh	4.5	10.5	--	--
West Bengal	--	10.5	6.3	--

Average katha yield per trees by the country method (Handi method) is estimated as under –

Tree size girth in cms	Average katha yield in kg
31-38	0.210
39-45	0.455
Over 45	0.900

(c) Marketing of Katha and Cutch

Katha is marketed in the form of irregular pieces and small square tablets or blocks of grayish brown colour, which when fairly pure, exhibit crystalline feature. No regular statistics are however, available for the widely scattered production of katha and cutch by the cottage scale manufacturers whose total production may safely be placed at least as equal to the factory production, if not more.

There are eight katha factories in U.P. located at Izzatnagar, Bareilly Haldwani and Najibabad. It is in existence for past 50 years or so, while the other are of present origin. The factory at Izzatnagar processes about 10,000 tons of katha wood and produces about 500 tons of katha and 1,000 tons of cutch. The remaining factories utilize about 15,000 tons of heartwood and produce about 400 tons of katha and 1,000 tons of cutch. Their annual capacity varies from 1,000 to 3,000 tons of heartwood.

Markets and Depots

Following are some of the important Khair wood markets and depots in Northern India.

Haryana - Sonapat, Chachrauli, etc.

Punjab - Roopnagar, Hoshiarpur, Pathankot, Dausya, etc.

Uttar Pradesh - Kishanpur, Gorakhpur, Tulsipur, Najibabad, Gonda, Bareilly, Lakhimpur, Bahraich, Bijnore, etc.

Uttaranchal - Raiwala

Maharashtra - Chanda, Mhasrul, Kasa, Thane, etc.

Gujarat - Waghai, Songarh, etc.

Bihar - Hazaribagh, Monghyr, etc.

Madhya Pradesh - Sidhi, Panna, Damoh, Sarguja, Sagar, Jabalpur, Sheopur, etc.

Source Institutions for Detailed Information

Detailed information can be obtained from Institutes listed below:

1. Forest Research Institute, Dehradun, Uttranchal.
2. State Forest Departments and Forest Development Corporations of U.P., Bihar, Orissa, Punjab, Maharashtra, Gujarat, Uttranchal.
3. Katha factories
4. Tropical Forest Research Institute, Jabalpur.

Source: Indian Council of Forestry Research and Education, Dehradun. Khair (*Acacia catechu*). Dehradun, Forest Research Institute. 24p.