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Gymnosperms of District Bilaspur of Himachal Pradesh, India

Research Article

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Abstract

Spermatophytes are the seed bearing plants which are divided into gymnosperms and angiosperms. Gymnosperms, a group of naked seed bearing plants, have 83 genera and 1079 species (Shu- Miaw Chaw, Edi Sudianto, in Advances in Botanical Research, 2018). To the best of my knowledge it is the first quantitative study of diversity of gymnosperms of this district. During the field survey, eight different species of gymnosperms viz. *Araucaria columnaris, Cedrus deodara, Cupressus sempervirens, Cycas revoluta, Pinus patula, Pinus roxburghii, Pinus wallichiana* and *Platycladus* orientalis have been collected and identified from the District Bilaspur of Himachal Pradesh. These species of gymnosperms are known to have economic, ecological and ethnobotanical importance. The present study and survey are important with respect to the diversity of gymnosperms and their uses. This effort may awaken the local people, to be more conscious about the plant wealth as well as its sustainable use.

Introduction

Gymnosperms are the plants with naked ovules. The main objective of this paper is to identify the gymnosperms of the District Bilaspur of Himachal Pradesh. Their systematics, common names, vernacular names, citations, morphological characteristics, flowering (Cones/Strobili) and seed seasons, places of collection, habitat, their distribution in the World, India, and in Himachal Pradesh along with economic importance are mentioned in this paper.

Bilaspur is the second smallest and one of the twelve districts of Himachal Pradesh (Figure 1). This is situated in Shivalik Hills of Western Himalayas. The river Satluj flows through the district Bilaspur for about 90 KM. This river enters the district Bilaspur at KARAHI KA GHARAT near the village Kasol (now- a- days famous for Kol Dam) and leaving it at the village NEILA near the Bhakhra Dam. Having an area of 1167 Sq. Km. its altitude varies from 290 to 1980 meters from the mean sea level. It is known for its climatic, geographical and floral diversity.

Materials and Methods

Extensive field survey of the District Bilaspur was carried out during different seasons for exploring the various species of gymnosperms. Standard procedures were followed for the collection, preservation and identification of gymnosperms. Important characters of gymnospermic plants were noted and their coloured photographs were taken in the field. Herbarium mounts were prepared for record and identification. For describing and identifying the plants, we have followed the terminologies used by Harris and Harris (1994), Jain and Rao (1977), Polunin and Stainton (1984), Stainton (1988) and Womersley (1981). Their nomenclature is in accordance with the International Code of Nomenclature (ICN), International Plant Names Index (IPNI) and The Plant List (2013). The Natural System of Classification of Spermatophytes, given by Bentham and Hooker (1862-1883) and Hooker (1872-1897) along with

latest amendments (Chase and Reveal, 2009) has been followed in this paper. The identified gymnospermic plants have been described alphabetically.

Observations

Extensive survey of the district Bilaspur during different seasons has been carried out from 2011 to 2014. A total of 08 species belonging to 06 genera and 04 families have been reported from the territory of this district. 07 species of gymnosperms are reported to be timber yielding, 04 species as ornamental while single species (*Cycas*) is the source of sago. Pinaceae is the most dominant family with four genera, Cupressaceae represented by two genera while one genera each in case of Araucariaceae and Cycadaceae.

Pinus patula has been reported for the first time from this region. Two plants of *Cedrus deodara* are growing successfully at an altitude of 375 meters in the nursery garden of ACC Ltd. Barmana. Dense forest of *Cedrus deodara* and *Pinus wallichiana* is reported at Bahadurpur (1980 meters). *Pinus roxburghii* is the dominant species of gymnosperms of this area. This species is abundant in Swarghat, Ghumarwin, Bharari, Jhandutta and Kalol Forest Ranges. However it is less abundant in Sadar Forest Range. *Araucaria, Cupressus, Cycas* and *Platycladus* are the ornamental gymnosperms of the area.



Results and Dicussions

Eight different species of gymnosperms viz. Araucaria columnaris, Cedrus deodara, Cupressus sempervirens, Cycas revoluta, Pinus patula, Pinus roxburghii, Pinus wallichiana and Platycladus oriental are collected and identified from the District Bilaspur of Himachal Pradesh. These are described below:

1. Araucaria columnaris (G. Forster) Hook. Sweet.Hort. Brit. ed. 2: 475. 1830; Bot. Mag. 78: t. 4635. 1852. Dallimore & Jackson, Hbk. Conif. & Ginkgo. 113. 1923; Raizada & Sahni, Living Ind. Gymno. Ind. For. Rec. (n.s.) Botany 5 (2): 108. t. IV. f.2. 1960; Keeth & Rushforth, Conifers, 90. 1987; Sahni, Gymno. Ind. & Adj. Countr. 53. t.8. f.2. 1990; Gaur. Fl. Garh. NW. Himal. 52. 1999.syn. Araucaria cookii R. Br. Ex Lindl. Family Araucariaceae. COLUMNAR ARAUCARIA, COOK'S ARAUCARIA, COOK'S PINE. Vern.: Araucaria. Figure 2.



Figure 2: Araucaria columnaris (G. Forster) Hook. Sweet., syn. Araucaria cookii R. Br. ex Lindl. COLUMNAR ARAUCARIA, COOK'S ARAUCARIA, COOK'S PINE. Vern.: Araucaria.

A tree, 30-61 m high, with the peculiar habit of shedding its lower branches and replacing them by short shoots from adventitious buds producing the effect of a dense green column that widens out within a short distance of the apex. Crown is columnar. Branches horizontal, lateral branchlets long, slender whip-like. Outer bark shedding off in thin papery layers. Leaves on older shoots broadly ovate, 0.2-0.4 x 0.12 cm, pointed, rigid, closely overlapping and curving inwards, on juvenile shoots triangular or lance shaped, up to 0.5-0.7 cm long, pointed. Male Strobili (Catkins) 2.5-7 cm long, 0.5-0.1 cm wide, set in a cup-like arrangement of leaves. Female Cones ellipsoid, 12-15 cm long, 9-11 cm wide, teasel-like when partly developed owing to the scale appendages, scales ca 3.3 cm in across, with a central seed margined by well developed wings, scales about 1.5 cm across with a central seed margined by well-developed wings, each 1.5 cm wide, terminal spines about 1.8-2 cm long. Flowering and Fruiting: February-May.

Specimens examined: Bilaspur, 25 July, 2011, Mahender. 192, 193.

Habitat: A low land, fast growing tree grows well in exposed and dry slopes and plains. It is also grown for decorative purposes, in house lawns and gardens.

Distribution: Native to New Caledonia and Polynesia. It was discovered by Captain Cooke during his voyage in the Pacific. It is widely introduced in the sub-continent. **India:** Throughout India, cultivated for ornamental purposes. **Altitude**: 400-1500 m.

Economic and Ethnobotanical Uses: It is a popular landscape tree and is widely cultivated as ornamental plant in houses, gardens and various Government and Private Institutions [35,38]. Wood is used for carpentry work [2] (Ambasta, 1986; Raizada and Sahni, 1960; and Sahni, 1990).

2. Cedrus deodara (Roxb. ex D. Don) G. Don in Loud. Hort. Brit. Ed. 388. 1830; Troup, Silvi. Ind. Trees III: 1096. f. 445-448. 1921; Raizada & Sahni, Living Ind. Gymno. Ind. For. Rec. (n.s.) Botany 5 (2): 129. f.9. t. VIII. f.4. 1960; FBH. 2. 1977; Polunin & Stainton, Fls. Himal. 386. f.510. 1984; Naithani, Fl. Chamoli 2: 762. 1985; Stainton, Fls. Himal. Supplement 59. t.112. f.499. 1988; Sahni, Gymno. India & Adj. Countr. 86. t.13. f.1. 1990; FLS. 580. 1994; FK. 707. 1999; Gaur, Fl. Garhwal. 51. 1999; FGHNP. 269. 2000; FSIR. 698. 2004; FC. 830. 2006. Pinus deodara Roxb. (Hort. Beng. 69. 1814, nom.nud.) ex D. Don in Lamb. Descr. Genus Pinus 2: 8. 1824; Roxb., Fl. Indica. ed. 2.3. 651. 1832. Cedrus libani Barell var. deodara (Roxb. ex D. Don) Hook.f. in Himal. J. 1: 257. 1854; FBI. 5: 653. 1888; FS. 486. f.159. 1902, 1921; PP. 40. 1916. Cedrus deodara Loud. Stewart. PP. 220. 1869; Kanjilal, For. Fl. Chakrata, Dehradun & Sharanpur. 549. 1901; Brandis, Ind. Trees. 691. 1906; FF. 544. 1918. Family Pinaceae. THE DEODAR, TRUE CEDARS, HIMALAYAN CEDAR. Vern.: Dedwar, Deodar, Dewdár, Deyar, Geyar, Kalain, Kalon, Kelu, Kilan, Kilankaper (Figure 3).

A long-living, very large, evergreen tree up to 80-90 m in height and 12-15 m in girth, young trees cone-like in appearance, but old ones usually with rounded and flattened tops. Bark green or gray, thin and smooth on young trees, but 0.5-3 cm thick, dark grayish brown, dark brown, sometimes reddish or black, divided into irregular oblong scales or plates with vertical as well as diagonal cracks, quite rough, deeply furrowed in old stems. Blaze is 3.8-5 cm, pinkish brown. Branches are irregular, horizontal, slightly ascending, descending or spreading, never in whorls, leading shoots and tips of branches usually drooping. Young or New shoots with pale green leaves appear in March or early April and are covered with grayish down. Shoots (Branchelets) dimorphic. Long shoots or shoots of unlimited growth long, slender, bearing scaly leaves, spirally arranged foliar leaves and dwarf shoots. Dwarf shoots or shoots of limited growth are short, thick, bearing tufts of leaves (15-20) in pseudo whorls. Every year it elongates slightly and a new whorl of leaves is added, successive years



Figure 3: Cedrus deodara (Roxb. ex D. Don) G. Don, syn. Pinus deodara Roxb. (Hort); Cedrus libani Barell var. deodara (Roxb. ex D. Don) Hook.f.; Cedrus deodara Loud. THE DEODAR, TRUE CEDARS, HIMALAYAN CEDAR. Vern.: Deodar, Dewdár, Deyar, Kelu. .

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of growth being marked by a ring of re-curved bud scales; sometimes bears flowers or occasionally develop into long shoots. Winter buds small, ovoid, with brown scales, which persist on the shots even after the appearance of young leaves. Leaves dark green, 2.5-5 cm long, acicular, stiff or rigid, sharply pointed, triquetrous (3-sided), glaucous or silvery, amphistomatic with two rows of marginal resin canals on the inner surface, persistent, lasting 1-6 years. Leaf shedding occurs in May or sometimes in October-November at the time of cone ripening. Strobili (cones or flowers) solitary, erect, terminal borne on short shoots, appearing in July-August, maturing during late September, unisexual and dioecious, sometimes monoecious, in latter case, they are borne on separate branches. Male cones solitary, terminal on dwarf shoots, oblong, ovoid or cylindrical, 2.5-4.5 cm long and 1-1.5 cm in diameter, pale green when young, yellowishgreen with purplish tinge when mature, each consisting of numerous microsporophylls (stamens) arranged spirally on a broad central axis, each stamen with two abaxially placed, oblong microsporangia or pollen sacs, the connective of which is produced into a flattened ovate, obtuse, upturned, beak-like appendage with an irregularly crenulate margin. Depending upon the altitude, locality and season male cones appear during March-June, and shed their pollens from September to October. Before shedding, they elongate rapidly to 5-7.5 cm in length and turn yellow. Pollen grains are winged, golden. Pollination occurs in October. Young Female strobili or cones appear in August, erect, solitary, terminal on dwarf shoots, arising progressively every year towards the terminal end on the upper side of horizontal branches, scaly leaves of unequal sizes enclosing the young cones, each consisting of a broad central axils on which are present spirally arranged bract scales, in the axis of which are present fan-shaped ovuliferous scales bearing two inverted ovules on the adaxial surface. Many of the ovuliferous scales present at the base and apex are sterile. At the time of pollination the cones are difficult to find as they are inconspicuous and partly hidden by rosettes of leaves. They are narrowed to a claw-like process at the base, bract scales often enlarging after flowering time and larger than the ovuliferous scales. They are pale glaucous green, oblong or ovoid, 1.2-2 cm long and 0.6 cm in diam. They are however, in an open state to receive pollen grains, as the scales stand perpendicular to the axis and the ovules are exposed. After pollination, the sporophylls grow slightly and cone becomes compact and finally closes. Growth ceases until the following spring, i.e. March of next year. By early part of May next, they become barrel shaped and increase to 8-12 cm in length and 5-8 cm in diam, with fan shaped, 3-3.5 cm broad ovuliferous scales. By the end of June or during July, they become full sized and are pale bluish green. During August they turn chocolate-brown, ripen from September to November and finally turn woody and brown in colour. Thus the time taken from the first appearance of the female strobili to the ripening of cones is about 121/2 - 131/2 months. Ripe (Mature) Female cones large, 10-15 cm by 7.5-10 cm, erect, barrelshaped, ovoid, ellipsoidal or cylindrical, brown, resinous, on short stout stalks, bracts minute or absent, ovuliferous scales woody, closely overlapping, fan shaped with a basal stalk-like claw, breaking up on the tree and shedding the winged seeds along with cone scales, the central axis persisting for a long time on the tree. Seeds pale brown, triangular, two to each ovuliferous scale, winged, each with a broad membranous apical wing, 0.8-1.6 cm long (with wings 2.5-3.8 cm

long), wings with round corners, larger than the seeds, being 1.7-2.5 cm. **Germination** epigeous. **Cotyledons** 9-11. **Seed shedding** up to December in certain localities. At the time of shedding, the cone breaks up on the tree, the scales and seeds falling to the ground and persistent woody axis remaining for years on the branches.

Specimens examined: Bahadurpur, 17 April, 2010, Mahender. 67, 68.

Habitat: Evergreen pyramidal shaped trees, typically gregarious, often found in pure stands, common in temperate slopes, also found in association with *Picea smithiana* and *Pinus wallichiana*, and infrequently with oaks, maple, cherries, chestnuts and other broadleaved species, often planted in hill stations in Europe, America and other parts of the world. **Distribution:** Afghanistan, Asia Minor, Atlas mountains (Africa, Algeria), Cyprus, Mediterranean mountains, Nepal (Kurnauli valley), Pakistan (Chitral, Dir, Dungagale, Hazara, Kagan valley, Thundi, Trans Indus), Syrian mountains, W. Himalayas. India: Jammu & Kashmir, Uttarakhand (Almora, Chakrata, Jaunsar, Kumaon, Mussoorie, Nainital, Ranikhet, Tehri-Garhwal).

Himachal Pradesh: Chamba (Dalhousie, Kala Top, Khajjiyar, Pangi, Tisa), Kangra (Bara-Bangal, Chhota-Bangal, Dhauladhar near Mc Cleodganj to Dharamkot, Palampur, Tathwani), Kinnaur (Jangi, Kalpa, Nichar, Rundung, Ralli), Kullu (Bahu, Banjar, Chowai, Jaloripass, Khanag, Kullu, Manali, Manikaran, Nagar, Pulga, Seraj), Lahaul & Spiti (Kali, Miyarnala, Lahaul), Mandi (Junee, Karsog, Mandi, Nachan, Suket), Shimla (Baghi, Bushahr, Boileauganj, Chaajpur, Charabra, Chopal, Chota Shimla, Fagu, Glen, Jakhoo Hills, Jubbal, Khadrala, Kharapathar, Kotgarh, Kufri, Mahasu, Nankheri, Naldhera, Potter's Hill, Rohru, Summer Hill, Tara Devi), Solan (Kasauli, Solan), Sirmaur (Churdhar, Haipurdhar, Haban, Nauradhar, Rajgarh). Altitude: 1200-3300 m.

Economic and Ethnobotanic Uses: The largest deodars are usually found near temples, where they are venerated and protected from injury. As an ornamental tree there are few trees in the World that can be compared with deodar. In Ayurveda all parts are considered bitter, hot, pungent, light oleagenous, useful in belching, inflammations, dyspepsia, insomnia, hiccough, fever, urinary discharges, ozoena, bronchitis, itching, elephantiasis, tuberculous glands, leucoderma, ophthalmia, piles, disorders of the mind, diseases of the skin and of the blood. The leaves lessen inflammation, applied in tuberculous glands. Needles contain ascorbic acid and yield an essential oil [24,27,34]. Its wood is the strongest, most valuable and the best among coniferous woods. It is an important constructional timber and is extensively employed for construction, beams, floor boards, posts, cooperage, door and window frames, furniture, packing cases, spars and shingles and railway sleepers. The average life of sleepers is 15 years. It is also used for bridge construction, wagon building, brush backs, carriages and several other purposes. It is suitable for pattern making, poles for carrying high tension lines, battery separators, and second grade pencils [2,40,41]. Wood is bitter, diuretic, diaphoretic, carminative, expectorant, useful in rheumatism, piles, palsy, epilepsy, stones in the kidney and bladder, prolapsusracti, fever, flatulence, heart palpitations, paralysis, dropsy and urinary diseases [27,34,43]. In gonorrhoea, syphilis, gout and rheumatism, its decoction is given as a powerful alternative with turmeric and

guggulu (Commiphora mukul) [47]. Due to the presence of oil, seasoned heartwood is durable and is rarely attacked by white ants and fungi [44]. In Kangra the wood is pounded with water on a stone, and the paste is applied to temple to relieve headache [47]. The wood on steam distillation yields an oleoresin and a golden yellow, reddish brown or dark coloured essential oil known as Himalayan Cedar wood oil with characteristic balsamic odour [27, 43]. It has been used since ancient times in Ayurvedic and Yunani systems of medicine for the treatment of rheumatoid arthritis, ulcers and skin diseases. It is also massaged in lumbago and urticaria. The oil is used as a substitute for true cedar wood oil in soap perfumery, but it is too expensive. It also shows anti-inflammatory activity. The oil is analgesic, diaphoretic and alexipharmic, useful for bruises and injuries to joints, boils, tuberculous glands, skin diseases. The bark is used in diarrhoea and dysentery. Aqueous paste of bark is used in bowel complaints and externally applied on piles [17, 27, 34]. (Simson and Rau, 1922; Kirtikar and Basu, 1935; Raizada and Sahni, 1960; Ambasta, 1986; Gaur, 1999; Joshi, 2000; Pullaiah, 2002; Seth, 2003, 2006; Sharma, 2003; and Singh and Kumar, 2000).

3. Cupressus sempervirens L. Sp. Pl. 1002, 1753; Kanjilal, For. Fl. Chakrata, Dehradun & Saharanpur. 544. 1901; Brandis, Ind. Trees. 693. 1906; FF. 546. 1918; Troup, Silvi. Ind. trees III: 1161. 1921; Raizada & Sahni, Living Ind. Gymno. Ind. For. Rec. (n.s.) Botany 5 (2): 143. t.IX. f.2. 1960; Dallimore& Jackson. Hbk. Conif. & Ginkgo. Rev. Harrison 214. 1966; Sahni, Gymno. India & Adj. Countr. 109. t.22. f.2. 1990.*Cupressus sempervirens* Willd. Stewart, PP. 222. 1869. Family Cupressaceae. ITALIAN CYPRESS, MEDITERRANEAN CYPRESS, PYRAMIDAL CYPRESS. Vern.: Sara, Saras, Saru. Figure 4.



Wild. ITALIAN CYPRESS, MEDITERRANEAN CYPRESS, PYRAMIDAL CYPRESS. Vern.: Sara, Saras, Saru.

It is a tree of 20-30 m height, spreading habit like that of a cedar or with erect branches nearly parallel to the stem having columnar shaped crown. A very slow growing long- lived tree, an age of 2000-3000 being on record. It has an erect trunk. Bark thin, smooth, greyish- brown, fibrous and furrowed and fissured longitudinally. Branches are ascending, not whorled. Branchlets alternate, tripinnate, irregularly spreading, the ultimate division 4-angled, deep green. Leaves in 4-equal ranks, blunt, often marked on the back with a longitudinal furrow, closely adpressed tips, so that the branchlets are not rough to the touch. Male strobili yellow, ca 2.5 mm long, stamens in ca 10 pairs. Female cone solitary or few together, ca 3-4 cm in diameter; shining brown or greyish, sub- globose or ovoid on short-curved stalks; scales 8-14, rising to a point in the centre or flattened with a thin ridge-like process. Seeds8-20 on each scale, ca 0.42 cm long, winged, without resin tubercles. The cones take 2 years to mature. It has 2 typical varieties, the spreading form var. horizontalis and the pyramidal or columnar form var. sempervirens. Flowering: Male strobili appear in August-October; ripening and shedding January-February. Fruiting: Female cones ripen in the second year. The cones open and shed from August-December.

Specimens examined: Auhar, 7 May, 2013, Mahender, 389.

Habitat: Grows wild in regions bordering the eastern Mediterranean. In India it is widely planted as an ornamental plant in gardens. Distribution: Asia Minor, Burma, Bulgaria, Cypress, France, Greece, Italy, N. Persia, Portugal, Russia, Sicily, Spain, Switzerland, Syria. India: Extensively cultivated in Agra, Dehradun, Delhi, Srinagar, Shimla. Altitude: 924-2400m.

Economic and Ethnobotanical Uses: It is widely planted as an ornamental tree [1]. Leaves yield an essential oil, which is used in perfumery and in soaps; it is also used for whooping cough [27]. Wood is used for boxes, furniture and building purposes [2]. It is astringent and anthelmintic. Seed oil is used for massaging in muscle pains. Cones are anthelmintic and useful in piles [27]. (Kirtikar & Basu, 1935; Ambasta, 1986; Agarwal, 2003).

4. Cycas revoluta Thunb. Fl. Japan 22, 1784; Brandis, Ind. Trees. 698. 1906; FF. 551. 1918; Raizada & Sahni, Liv. Ind. Gymnosperms. Ind. For. Rec. (n.s.) Botany 5 (2): 94. t.1. f.1. 1960; Sahni, Gymno. India & Adj. Countr. 26. t.1. f.1. 1990.Family Cycadaceae. SAGO CYCAS. Figure 5.



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A dioecious tree or shrub, 3-6 m tall, the largest known trees 8 m tall are seen in Tyugeji temple in Tokyo. Trunk is cylindrical, with a crown of glossy, fern-like, stiff but gracefully revolute margin of the pinnate leaves; covered with compacted woody bases of petioles. Bark brown, smooth below, with scars of fallen leaflets. Leaves pinnate, ovate, laciniate nearly to the midrib with 12-20 linear curved spinous segment or leaflets; short distant spines at right angles to the petiole or slightly deflexed near the base ovate, 1.3-2 m long; petiole 0.3-0.5 m long; new leaves appear in March-April. Leaflets are of 12-20 pairs, alternate 10-25 cm long, 5-9 mm wide, blunt or acute, margins revolute. Male cone shortly peduncled c 23 cm long, 4-6 cm in diameter, male cones mature to 30 cm in length in July; microsporophylls 2.5-4 cm long, 1-1.2 cm wide, ovate-deltoid, prolonged into an up curved subulate spine, c 2 cm long, clothed with a brown tomentum externally, glabrous above. Megasporophylls forming as apical crown in a rosette form, densely hairy, stalk longer than blade with 4-6 ovules that are covered with thick brown hairs. Ovules 5-10 per megasporophyll. Seeds flattened, glabrous 1.5-3.5 cm long, apex emarginated, bright orange or yellow.

Specimens examined: Barmana, 4 April, 2008, Mahender. 13, 14.

Habitat: It is a slow growing, palm-like tree. This cycad is most widely cultivated in gardens in the Indian subcontinent including Sri Lanka. **Distribution:** China, S. Japan, Taiwan. **India:** Commonly the female trees are found introduced in India. A few male trees are planted in the Botanical Garden of the Forest Research Institute Dehradun. **Himachal Pradesh:** Mostly cultivated as an ornamental plant in gardens.

Economic and Ethnobotanic Uses: This cycad is most widely cultivated in gardens as ornamental plant [2]. The pith yields Sago and the seeds can be eaten being rich in protein. The leaves after silvering are made into funeral wreaths. Root tubers contain starch [2, 35]. (Raizada and Sahni, 1960; and Ambasta, 1986).

5. *Pinus patula* Schiede ex Schltdl. & Cham., Linnaea **6**: 354. 1831. **Family Pinaceae.** PATULA PINE, PINO PATULA, SPREADING-LEAVED PINE, MEXICAN WEEPING PINE. Figure **6**.

It is a large, evergreen tree, up to 40 m in height and 1 m in diameter below breast height. Stem usually with a single, straight, slender trunk; in closed canopy stands. First-order branches are long, slender, spreading or slightly ascending; higher order branches are slender, drooping, the ultimate branches pendent. The shoots are rough and scaly when the leaf fascicles have fallen, yellow or redbrown, foliage shoots with prominent, decurrent pulvini. Cataphylls subulate, recurved at apex, scarious, with erose-cliate margins, brown, early deciduous. Vegetative buds oblong-cylindrical; the terminal bud 15-20 mm long; and the lateral buds shorter, brown, not resinous. The scales are spreading, subulate, with ciliate margins. Fascicle sheaths initially 20-30 mm long with 6-8 imbricate, chartaceous, white-yellow or orange-brown scales, persistent but shortening to 12-15 mm in mature fascicles, slowly weathering to grey-brown. Bark is thin, scaly, red-brown on young trees; becoming thick, dark grey-brown, rough and scaly with large elongated plates and deep longitudinal fissures on mature plants. Leaves in fascicles of 3, sometimes 4-5, in drooping tufts, in two rows on either side of the



Figure 6: *Pinus patula* Schiede ex Schitdl. & Cham., PATULA PINE, PINO PATULA, SPREADING-LEAVED PINE, MEXICAN WEEPING PINE.

upturned shoot, persisting for 2-3 years, thin, lax, drooping-pendent, serrulate at the margins, acute, pale-dark green; triangular in outline; stomata on all sides. MALE CONES crowded near the proximal end of new shoots, spreading, subtended by scarious bracts, ovoid-oblong to cylindrical, 15-20 x 5-6 mm, pink-yellow, finally yellow-brown. FEMALE CONES sub-terminal or lateral in position, in whorls of 2 to many, rarely solitary, persistent or deciduous, peduncles up to 20 mm long. Young Cones are ovoid, on recurved peduncels with persistent calaphylls, purple turning light brown, maturing in two seasons. Mature Cones narrowly ovoid when closed slightly curved, asymmetrical at base, 5-12x3-6 cm when open. Megasporophylls 100-150, serotinous or parting sometime after maturing, tenacious or deciduous with the peduncle, woody, oblong, usually curved when spreading, the proximal megasporophylls connate, purple-brown to dark brown, with adaxial light brown marks left by the seed wings. Apophysis is flat to slightly raised, transversely keeled, gibbous on proximal sporophylls, rhomboid, upper margin acute or obtuserounded, abaxial surface striate or smooth, lustrous or yellow-brown. Umbo is dorsal, flat or raised, sunken into the apophysis, 3-7 mm wide, grey, with a minute, deciduous prickle. Seeds obliquely ovoid, flattened, 4-6x2-4 mm, dark grey. Seed wings articulate, held to the seed by two oblique claws which partly cover the seed on one side, obliquely ovate-oblong, 12-18x5-8 mm, light brown with dark stripes.

Specimens examined: Barmana, 23 May, 2009, Mahender. 130.

Distribution: Native of Mexico. It is planted at high altitudes in Ecuador, Bolivia, Colombia, Kenya, Tanzania, Angola, Zimbabwe, Papua New Guinea and Hawaii. At lower altitudes it is cultivated in S. Brazil, S. Africa, India and Argentina. It has been introduced in New South Wales, Australia and in New Zealand. It is cultivated in United Kingdom as an ornamental tree. India: Himachal Pradesh.

Economic and Ethnobotanic Uses: Wood is used as timber. Needles are the source of green dye. Turpentine oil is used in the treatment of kidney and bladder complaints as well as in rheumatic affections. It is also beneficial in cough, cold, influenza and TB.

6. Pinus roxburghii Sarg., in Silva N. Amer. 2: 9.1897; Raizada & Sahni in Ind. For. Rec. n.s. 5(2): 115. t.V. f.1. 1960; Stewart in Nasir & Ali, Annot. Cat. Vasc. Pl. W. Pak. & Kashmir 25. 1972; FBH. 2. 1977; Polunin & Stainton, Fls. Himal. 388. f.511. 1984; Naithani, Fl. Chamoli 2: 763. 1985; Stainton, Fls. Himal. Suppl. 60. t.113. 1988; Sahni, Gymno. India & Adj. Countr. 66. t.10. f.1. 1990; FK. 708. 1999; Gaur, Fl. Garhwal. 51. 1999; FGHNP. 270. 2000; FSIR. 699. 2004; FC. 833. 2006. Pinus longifolia Roxb., Fl. Ind. 3: 651.1832; Stewart, PP. 226. 1869; Hook. f., FBI 5: 752. 1888; Kanjilal, For. Fl. Chakrata, Dehradun & Saharanpur. 548. 1901; FS. 485. f.158, 1902, 1921; Brandis, Ind. Trees. 690. 1906; PP. 39. 1916; FF. 538. 1918; Troup, Silvi. Ind. trees III: 1036. f. 413, 414. 1921. Family Pinaceae. CHIR PINE, LONG-LEAVED PINE, LONG-LEAVED INDIAN PINE, THREE-LEAVED PINE, HIMALAYAN LONG NEEDLE PINE. Vern.: Anander, Chil, Chir, Dhupasarala, Drabchir, Gula, Nakhtar, Nashtar, Ransuru, Salla, Saral, Thansa. Figure 7.



Figure 7: *Pinus roxburghii* Sarg., syn. *Pinus longifolia* Roxb. CHIR PINE, HIMALAYAN LONG NEEDLE OR INDIAN OR THREE-LEAVED PINE, Vern.: Chil, Chir, Gula, Salla.

It is a large tree up to 55 m in height and 4 m in girth, mostly evergreen, but occasionally partially deciduous in dry localities. Trunk is tall, straight, but sometimes stunted and gnarled. Crown up to middle age is elongated and more or less pyramidal, afterwards becoming spreading, rounded or umbrella-shaped with a massive branch system. Bark non¬-resinous, deeply and irregularly fissured, up to 6 cm thick; of young trees dark grey, exfoliating in rough, longitudinally elongated plates; of older trees darker, reddish or reddish brown, turning light-grey on exposure and shedding in large plates, up to 61 cm in length and 23 cm in breadth. Branches up to middle age whorled, with verticels, not well defined, spreading in mature trees. Shoots are of two kinds, i.e. dimorphic. Long shoots or shoots of unlimited growth grey or pale brown when young, covered with scale leaves, which persist for several years; bear foliar spurs and buds. Dwarf shoots or shoots of limited growth, bear three leaves and enclosed by usual two prophylls and 8-15 spirally arranged, imbricate, chartaceous, acuminate, fimbricate cataphylls (scales), which are at first white or green, later turning brown or grey. Both prophylls and cataphylls constitute 1.3-2.5 cm long, persistent basal sheath around the leaves. Dwarf shoots appear in March-April, but unfold in the following April, soon after the shedding of pollen. Winter buds small, ovoid, non-resinous, light-reddish brown, protected by closely pressed brown scales with fibrillar margins, formed in October or November, but growth ceases till December or early January. Leaves in fascicles of three, borne on dwarf shoots, light to deep green, nonglaucous, needle-like, slender, 15-40 cm long, margins minutely, but closely serrulate (i.e. finely toothed), apex narrowing into a long fine point, obscurely triquetrous, with one side rounded and two sides flat, having several faint lines of stomata on all the three surfaces and marginal resin canals; needles persist for 11/2-3 years, new ones appearing in January. Leaf shedding occurs in May and June. Strobili (Flowers or cones) unisexual and monoecious, bisexual cones have been reported by Rao (1932). Male strobili appear in January at low elevations, in groups, arranged spirally on the shoots of current year in 5/8 phyllotaxy; the whole inflorescence being 2.5-10.2 cm long by 3.8-5.1 cm in diameter, each male cone occupying the place of a dwarf shoot, borne in the axil of a prominent brown scale or a scale leaf (which falls as soon as the cone matures) and covered over by protruding, four prominent and numerous small, light-brown, acuminate scales with fimbricate margins. These bracts persist as they are held between the tightly packed other cones. Each cone consists of a central axis on which are born 90-140 spirally arranged microsporophylls with their tips becoming scaly and bending upwards, and each bearing two abaxial microsporangia. Cones are yellowish green and globular, when young, 1.3-1.8 cm long when ripening, and become cylindrical, ovoid, elongated, subtended by protruding, light brown, acuminate scales with fimbriate margins and light-reddish brown after the pollen is shed. Just prior to shedding, the central axis elongates considerably, especially at the base and reaches a length of 3-4 cm.

Pollen shedding during February-April, depending upon the altitude, locality and season. Pollen is shed in large quantities, ensuring fertilization by the agency of wind. **Female strobili** appearing in early February at low elevations are borne either singly or in pairs in one or two whorls of three each on the apices of young shoots. Young cones before pollination are pale-green or slightly purplish at first, erect, ovoid and covered by involucral bracts (in 5/8

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phyllotaxy), which persist for a year. In the cone are bract scales and ovuliferous scales. Prior to pollination the bract scales are longer than the ovuliferous scales and are more or less at right angles to cone axis, but the ovuliferous scales soon outgrow the bracts. Within one month of pollination, cones are green, 1.5-2 cm long. By the end of October, they are fairly soft (easily cut by a knife), turn greyish or light brown outside, remaining green inside and are 1.8-2.6 cm long by 1.5-2 cm in diameter. A reddish light-brown bud then appears at the tip of cone bearing shoot, which pushes the cone horizontally from its erect position. They are concealed within the fully grown new leaves and remain in this horizontal position throughout winter. Due to rapid growth and swelling (thickening of cell walls) of ovuliferous scales, cones become closed, the closing being also favoured by plenty of resin secretion, which also protects the young ovules from drying and can be seen in the form of large shining drops on the scales. Cones once again become green and active. By March, one year-old cones are green, soft, 2.5-4.6 cm by 2.5-3.8 cm having inconspicuously recurved scales with brown tips (remains of winter stage). In mid April they are 7.5-10.5 cm long, soft; green with recurved scales and general shape now resembling mature cones. By June or July the cones have reached full size, but are still green. In the beginning of winter cones are fully grown, hard and brown. They remain in this condition throughout winter. At higher elevation the cones may be 6 weeks late in development in comparison to the development of cones at low elevations. Mature female cones (24 months after pollination in the spring of third season) light-brown, long, ovoid, 11.5-21 cm long, 6.4-14 cm in diameter on short stout stalks, solitary or 2-5 together horizontally, pendulous or erect on branches, each consisting of a central axis and 95-115 spirally arranged pairs of bracts and ovuliferous scales, the former is a membranous structure at the base of ovuliferous scales, which are very thick, hard and woody, pyramidal or rhomboidal having two winged seeds at the base on the abaxial side and a prominent exposed part (umbo) with a pyramidal, pointed curved or reflexed beak. In the months of March-May of third year, cones begin to open only in dry weather, closing up again during rains. Open cones may be as big as 24 cm by 18 cm. Although the opening is rapid, seeds require good shaking by breeze and take 2-3 weeks (or up to July in cool localities) to escape completely. Thus the time taken from first appearance of female cones to their ripening and opening is nearly 26-27 months. Empty dry cones remain on the tree for a long time, sometimes for a year or so. Seeds 0.7-1.6 cm long by 0.5-0.6 cm wide, winged, with a long, thin membranous wing, 0.7-1 cm wide, seeds with wing measure 2.5-4.5 cm in length.

Germination: Epigeous.

Cotyledons 10-14. **Flowering and Fruiting:** 3-Year life cycle; January-February (Male cones), February-April (pollen shedding), February-April (1st year female cones, pollination), March (2nd year green, fertilized cones), March-July (3rd year brown, mature, woody female cones ready for seed shedding). The dry cones remain long on the tree.

Specimens examined: Chanjhiar, 27 Aug, 2011, Mahender. 131,132.

Habitat: Himalayan chir pine requires a monsoon rainfall and therefore, it is not seen in the inner valleys, where the monsoon does

not penetrate. Its seeds falling in the hot weather germinate as soon as the monsoon breaks. It is a gregarious species, and forms pure forests of considerable extent, although at lower and upper limits it occurs mixed with other species. It is the most important pine, which is roughly estimated to extend over about 8730 KM in the tropical, subtropical and temperate Himalayas. In H.P. and Uttarakhand twisted fibered trees also occur. Distribution: Afghanistan, Bhutan, Nepal, Pakistan (Dungagali, Hazara, Kahuta hills, Khanpur, Kurihar drainage, Muree, Pakhli plain, Rawalpindi, Siren valley, Thandian ranges), West and East Himalayas. India: Jammu & Kashmir (Jammu, Poonch), NEFA along the Kameng Frontier division, Siwalik hills flanking the Himalayas, Uttarakhand (Almora, Bawar, Bhagirathi, Bhilganga, Chakrata, Dehradun, Jamuna, Jaunsar, Kaliganga rivers, Kumaon Himalayas, Nainital, Ranikhet, Saharanpur, Tehri-Garhwal, Tons valley). Himachal Pradesh: Bilaspur (Sarium peak, Swarghat), Chamba (Bathri, Chamba, Dalhousie, Kathlog), Hamirpur (Hamirpur), Kangra (Dehragopipur, Dharamshala, Kangra, Nurpur, Palampur, Shiwalik), Kinnaur (Sungra), Kullu (Bahu, Banjar, both banks of Parbati river up to Manikaran, Hurla, lower Beas valleys, Kandugad, Kullu, Sainj, Seraj, Tirthan valley), Lahaul & Spiti, Mandi (Nachan, Suket), Shimla (Chadwick fall, Chirgaon, Chopal, Jubbal, Kotgarh, Kotkhai, Nogli, Pabber ranges, Pandrabeesh, Rampur Bushahr, Rohru, Shimla, Tara Devi, Taranda), Sirmaur (Haban, Kheradhar, Nahan, Rajgarh, Sangrah), Solan (Kasauli, Kunihar, Solan), Una. Altitude: 450-2450 m, thriving best at 610-1525 m.

Economic and Ethnobotanic Uses: It produces resin of commercial importance. Under favorable conditions the revenue derived from resin is much higher than that derived from its timber or fuel. Internally the resin is used as a stomachic and externally as a plaster; and is applied to buboes and abscesses for suppuration. The resin is stimulant both externally and internally. Internally it acts chiefly on the mucous membrane of the genito-urinary organs. Rosin is used in the preparation of soap, sizing of paper and cloth; also used in manufacture of linoleum, sealing-wax, oil cloth, lubricating compounds and inks [27,55]. The turpentine oil is used in pharmaceutical preparations, perfumery industry, synthetic pine oils, disinfectants, insecticides and denaturants; used as a solvent for paints and varnishes. The oil is valued in medicines and is included in India Pharmacopoeia. It is feebly antiseptic and an expectorant; is useful in chronic bronchitis. It is especially recommended in the treatment of gangrene of the lungs and has been found beneficial as a carminative in flatulent colic, also arrests minor hemorrhages in tooth sockets and nose [10,27,48,55]. The gum is sweet, bitter, pungent, acrid, heating, oleagenous, purgative, carminative, aphrodisiac, fattening, diuretic, anthelmintic, analgesic, intestinal antiseptic; causes biliousness, useful in diseases of the vagina and uterus, the head, the eye, the ear, the throat, the blood, and the skin; good in bronchitis, dyspepsia, ulcers, diaphoresis, giddiness, scabies, foetid odour of the body, inflammations and itching. The gum has a bad smell and taste, emmenagogue, expectorant, useful in asthma, chronic bronchitis, ozoema, piles, diseases of the liver and spleen, gleets, urinary discharges, earache, toothache, lumbago, tuberculous glands, scabies, epilepsy, etc. The chir pine needles yield oil, which is reported to have antibacterial activity against a number of organisms. Bark is used for tanning [10,27,43,47].

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Chir **wood** is used for joinery work, shingles, packing cases, constructional work, light furniture, house fitments, pattern making, cores for lamin boards, drawing boards and plane tables [2,40,43,54,55]. Treated wood is used for railway sleepers which may lasts for 16-17 years. The wood is considered stimulant, diaphoretic and useful in burning of the body, cough, fainting and ulcerations. The wood and the oleoresin have been recommended for the treatment of snake bite. The **seeds** from unripe female cones are boiled in milk for making "khir", which is taken for insomnia and provides sound sleep. Resin is applied on cracks of heels [40,42]. (Watt, 1889-1893; Kirtikar and Basu, 1935; Singh *et al.*, 1983; Ambasta, 1986; Warrier *et al.*, 1994; Chauhan, 1999; Singh and Kumar, 2000; Pullaiah, 2002; Sharma, 2003; Seth, 2003; and Seth and Jaswal, 2004)

7. Pinus wallichiana A.B. Jackson in Kew Bull. 1838: 85. 1838; Raizada & Sahni in Ind. For. Rec. n.s. 5(2): 111. t.V. f.2. 1960; Gupta, Fl. Nainital. 439. 1968; Hara et al., Enum. Flow. Pls. Nepal 1: 26. 1978; Polunin & Stainton, Fls. Himal. 387. f.511. 1984; Naithani, Fl. Chamoli. 2: 763. 1985; Stainton, Fls. Himal. Suppl. 60. t.110. 1988; Sahni, Gymn. India & Adj. Count. 58. t.10. f.2. 1990; FLS. 582. 1994; Gaur, Fl. Garhwal. 52. 1999; FK. 708. 1999; FGHNP. 271. 2000; FSIR. 699. 2004; FC. 834. 2006; Pinus excelsa Wallich ex D. Don in Lambert, Descr. Gen. Pinus 2: 5. t.3. 1824 (non Lam., 1778); Wallich list 6059. 1828; Stewart, PP. 225. 1869; FBI 5: 651. 1888; Kanjilal, For. Fl. Chakrata, Dehradun & Saharanpur. 547. 1901; FS. 484. f.157. 1902, 1921; Brandis, Ind. Trees. 689. 1906; PP. 39. 1916; FF. 540. 1918. Pinus griffithii Mc Clelland in W. Griff. Notul. Pl. Asiat. 4: 17. 1854; Kitamura in Kihara, Fauna & Fl. Nepal Himal. 81. t.9-12. 1955; FBH. 3. 1977. Family Pinaceae. BHUTAN PINE, BLUE PINE, HIMALAYAN BLUE PINE, INDIAN BLUE PINE. Vern.: Andal, Biar, Chil, Chir, Chiti, Darchil, Kail, Lem, Lim, Lhim, Lhimtser, Palsam, Partal, Sam, Shim, Somshing, Tser, Yari, Yero. Figure 8.

It is a tall, evergreen and graceful or elegant tree up to 50 m in height and 3 m in girth and considered as one of 'the most beautiful"



Figure 8: *Pinus wallichiana* A.B. Jackson, syn. *Pinus excelsa* Wallich ex D. Don; *Pinus griffithii* Mc Clelland. BHUTAN OR HIMALAYAN OR INDIAN BLUE PINE. Vern.: Kail, Lim, Lhim.

pines in the world. Branches are whorled, spreading, usually ascending in young trees and horizontal or drooping with upturned ends in old trees, uninodal or multinodal. Bark 1.3-2.8 cm, thin, smooth, resinous, greenish-white, greenish-grey or slate-coloured in young trees; grey or greyish-brown, corky, rough, scaly, superficially or shallowly fissured and divided into small, oblong, plates on the old trees. Winter buds small, cylindric-conical, 0.6-1.3 cm long, with numerous, lanceolate, fibrillar margined scales, either free or matted with resin. Shoots are dimorphic, i.e. of two types. Long shoots or shoots of unlimited growth, appearing in March or early April (depending upon locality), without down, glaucous, green or light-brown, darkening in colour with age. Dwarf shoots or shoots of limited growth or foliar spurs, borne on long shoot in the axils of scaly leaves, persistent, less than a millimeter in length, bearing five needles and enclosed by two prophylls and 8-10 spirally arranged (in 2/5 phyllotaxy) cataphylls, outermost being the smallest and innermost the largest, both prophylls and cataphylls deciduous, 1.3-2.3 cm long, forming a basal sheath around needles, which is with slightly fibrillar margins and a prominent midrib. Leaves borne in fascicles of five, rarely 4, 6 or even 7 in abnormal fascicles, persistent, lasting 3-4 years, erect and pointed upwards in young trees, but spreading or drooping and slightly bent in older trees; slender (thin and delicate), triquetrous, convex surface green, bluish or greyish-green, and glaucous on inner surface, giving the foliage its characteristic bluish tinge (colour), 10-21 cm long, shorter in stunted and diseased trees, margins minutely toothed, apex sharp pointed, ridged (ridges are epidermal projections between which the stomata are arranged in longitudinal rows), white stomatic lines on flat surfaces, resin canals marginal. Leaf shedding occurs in May-July, sometimes during October--December. New shoots appear in March-April and attain full size by August-September.

Strobili (Flowers, catkins or cones) are unisexual and monoecious. Male strobili in catkins, appearing in October-November, in 15-35 spirally arranged clusters, 1.3-5.1 cm long, at the base of current years young long shoots, each cone taking the place of a dwarf shoot and arising in the axil of a green, scaly leaf and enclosed by involucres of 8-12, equally prominent greenish-white, imbricate scales, which adhere to the catkins when it falls; cones when young are usually green, sometimes dark reddish-purple, ovoid or oblong, 0.7-1 cm long; when ripe yellow, light-brown or dark-brown and often pink towards the apex, elongated and 1-2 cm long, fall soon after ripening. Each cone consists of 85-115 spirally arranged microsporophylls (stamens) on a central axis, each stamen 0.1-0.15 cm long with its tip bent and extended upwards, and bears two microsporagia (pollen sacs) on its abaxial side. Pollination in April-June, depending upon the locality, season and altitude (the lower the altitude, earlier the cones shed their pollens). Female strobili terminal or sub-terminal, solitary or 2-3 together, sometimes more forming a whorl around the terminal bud, appear in February, when they replace the terminal or sub-terminal bud(s) of current years young long shoots, pale green, erect and protected by an involucre of bracts, pale or glaucous green turning to deep-pink or reddish purple and finally to greenishbrown at the time of pollination. In April cone axis elongates, cones protrude out of the involucre and measure 1.5-2 cm long and 0.8-1 cm in diameter with scales open to receive pollen. After pollination (end of April and beginning of June), the cones close and by August become 2.5-5.1 cm long by 1-1.3 cm in diameter, with 2.5-3.8 cm long peduncle or stalk, which elongates considerably after pollination, and cones become pendulous and bluish-green, with each scale being tipped with a small rudimentary brown umbo. Ripe (Mature) Female cones pendulous on 3.3-7.5 cm long stalks, cylindrical, 15-33 cm long and 3.0-6.5 cm in diameter before expansion, light-brown, very resinous and each consisting of 80-90 spirally arranged pairs of bracts and ovuliferous scales (megasporophylls) on a central axis, the latter arising in the axils of the former, the bract scales being small and membranous, but the ovuliferous scales being fleshy, about 3.8-6.5 cm long and 2.0-3.8 cm broad, wedge shaped, rhomboidal or spathulate, exposed portion longitudinally grooved with a thickened apex, the basal ones sometimes reflexed and each bearing two winged seeds on its abaxial side. Ovuliferous scales become woody and hard during later stages, but they are not as hard as in Pinus roxburghii. Ripening, opening and shedding of seeds occur during September-November of the second year. The time taken from the first appearance of the female flower to the ripening of the cone is approximately 18 months, and to the shedding of seeds is about 22 months. Seeds bluish or darkbrown, compressed, acute at both ends, ovoid, 0.5-1 cm by 0.3-0.5 cm, winged, 0.7-1 cm wide with wings, membranous, obliquely truncate, about 3 times the length of seeds; the size of the seeds with wings being 1.5-4 cm in length. Germination is epigeous. Cotyledons 8-12. Flowering and Fruiting: 2-Year life cycle; October-November (Male cones), February (1st year female cones), April-June (pollen shedding, pollination), September-November of the second year (Ripening, opening and shedding of seeds); cones remain on the branches long after the seeds have fallen.

Specimens examined: Bahadurpur, 17 April, 2009, Mahender. 133.

Habitat: Common on alpine slopes both in pure and mixed forests; also found in association with Picea smithiana and Abies pindrow. At higher elevations it is stunted and assumes a shrubby prostrate form (due to bending with snow). It can grow in areas where the annual rainfall is as less as 25 cm as in Suliman range or in areas where the annual rainfall is 510 cm as in Apa Tanang in E. Himalayas. Its altitudinal range (1200-3700 m) is also greater than any other Himalayan conifer. Distribution: Native of temperate Himalayas occurs throughout the greater Himalaya (West, Central and East) extending from Kafiristan (Baluchistan, Afghanistan) in the West to Arunachal Pradesh (India) in the East through the hills of Pakistan, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Nepal, Sikkim, Bhutan and SE. Tibet. Its latitudinal and longitudinal ranges are $25^{\rm o}N\text{-}36^{\rm o}N$ (latitude) and $68^{\rm o}E\text{-}100^{\rm o}E$ (longitude). In West Himalayas, it is abundant between 1830-2555 m, and extends westwards from Garhwal through Jaunsar, Chakrata, Mussoorie, Shimla, Bushahr, Kullu, Chamba, Kashmir (in India); Murree hills, Waziristan, Hazara (in Pakistan); and Kafiristan (in Afghanistan). In Central Himalayas it occurs at an altitude as high as 3600 m along the regions of Namchebazar and Thengopoche (in Nepal). In East Himalayas it extends eastwards from Chumbi valley across Sikkim border through lower Rangeet valley above the river Tista and then through Bhutan, where it is in abundance to small scattered patches on the north and east of Brahmputra in the NEFA at 1500-1830 m

at Kameng division, Khalaktang area, Rupa valley, Dirang-Dzong valley (500 m), Subansri division, and Apatanang valley. Himachal Pradesh: Chamba [726-2400 m; Chamba (726 m), Dalhousie (2036 m), Kala Top (2400 m), Khajjiyar (2000 m), Lakkarmandi, Tisa (1870 m)]. Kangra [Multhan, Chotta Bhanghal, Upper area of Boh]. Kinnaur (2200-2800 m); Kalpa (2800 m), Kinnaur, Nichar (2200 m), Kalpa (2800 m)]. Kullu [1500-2700 m; in all the valleys of GHNP; Bahu (1500 m), Banjar (2000 m), Chowai (2050 m), Gulaba forest, Jaloripass (2700 m), Kandugad (1700 m), Khanag (2692 m), Manali (2300 m), Manikaran (1737 m), Nagar (1768 m), Nohnoo (2600-2650 m), Pulga, Sojha (2692 m)]. Lahaul & Spiti [Lahaul, Pattan valley, near Kardang monastry, Trilokinath]. Mandi (760-2000 m); Junee (2000 m), Karsog (2050 m), Mandi (760 m), Nachan, Suket). Shimla [1500-3250 m; Bahali, Bashahr (1830-2440 m), Boileauganj (2050 m), Chadwick fall (1600 m), Chirgaon (1700 m), Chopal (2000-3200 m), Chotta Shimla (2150 m), Glen (1830 m), Hattoo peak (3250 m), Indian Institute of Advanced Studies (2100 m), Jubbal (2000 m), Kamnadevi (2175 m), Kotgarh, Naldehra (2149 m), Nankheri (3000 m), Narkanda (2700 m), Potter's Hill (2050 m), Roghi (2800 m), Rohru (1500-1535 m), Sarahan (3300 m), Shillaroo (2600 m), Summer Hill (2010 m), Tara Devi (1851-2050 m), Theog)]. Sirmaur [2250-3300 m; Haban, Kheradhar, Rajgarh (2250 m). Solan [1350-1928 m; Kasauli (1928 m), Solan (1350 m)]. Altitude: 1200-3800 m or more.

Economic and Ethnobotanical Uses: The plant is intestinal antiseptic; useful in diseases of the eye, the ear, the throat, blood and the skin; good in bronchitis, diaphoresis, giddiness, ulcers, inflammations, itching, etc [27. 55]. Its timber is fairly good. The sapwood is white and the heartwood is light brown. Kail wood is considered best next to deodar for internal fittings and planking of residential houses, furniture, packing cases, match boxes, drawing boards, fermentation vats, lorry bodies, shingles and railway sleepers; also used for other construction purposes, cheap pencils, battery separators, violins, joinery work, pattern making, cores for lamin boards, drawing boards and plane tables. Blue pine is usually considered to be slightly superior wood for most purposes. Treated wood is used for railway sleepers which may lasts for 16-17 years. Sometimes it is preferred to deodar as it is not so oily. It yields excellent charcoal. The more resinous parts of the wood are largely used for torches. Chips and small pieces of wood form an article of traffic in the treeless inner Himalaya under the name of "lashi or clanshing". The wood is considered stimulant, diaphoretic and useful in the burning of the body, cough, fainting and ulcerations [2, 43, 55]. Oleoresin (also sometimes referred to as Gum) is bitter, acrid, heating, oleagenous, purgative, carminative, expectorant, aphrodisiac, fattening, diuretic, anthelmintic, analgesic; causes biliousness; useful in inflammations; and in the diseases of the liver, spleen, vagina and the uterus, the head and the eye; good in dyspepsia, ulcers, diaphoresis, scabies, foetid odour of the body, asthma, chronic bronchitis, ozoena, piles, urinary discharges, gleet, earache, toothache, lumbago, tuberculous glands, scabies, epilepsy . Internally the resin is used as a stomachic and externally as a plaster and is applied to buboes and abscesses for suppuration and is a good remedy for gonnorhoea. It is applied in rheumatic pains. The resin from the young saplings is used as liniment for healing of the cuts and wounds. Oleoresin yield turpentine oil and rosin. The oleoresin is used for varnish and paints. Rosin is used in

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soap making, sizing of paper and cloth, also used in manufacture of sealing-wax, oil cloth, lubricating compounds and inks. The yield of oleoresin and turpentine oil is about half of chir pine, but the oil is of superior quality and has high pinene content and is suitable for all purposes, where American turpentine oil can be used. The wood and the oleoresin are recommended for the treatment of snake bite and scorpion stink [10,27,43,55]. Bark is used as fuel by blacksmiths. It contains a fair amount of colouring matter. The bark is used to roof huts. The bark in circular cylinders taken out of pole size plants is used as a bandage on the dislocated/fractured bones as a plaster for humans, cattle, sheep as well as goats. The resin and circular bark tied on the organ keeps the bones in place and facilitates calcification and unification of fractured pieces [10,27,55]. Cones are employed for lighting fires and are collected by local people for medicinal purposes. The needles (leaves) form admirable litter and in certain localities they are mixed with mortar and plaster in building. The needles are added to give consistency to mud used in plastering, also used as animal beds [17,48,50]. Needle oil shows antibacterial properties [27,43]. Seeds in the immature cones are largely eaten by monkeys, flying squirrels and birds. (Watt, 1889-1893; Kirtikar and Basu, 1935; Singh et al., 1983; Ambasta, 1986; Chauhan, 1999; Gaur, 1999; Singh and Rawat, 2000; and Sharma, 2003).

8. Platycladus orientalis (L.) Franco, Portugaliae Act. Biol., Sér. B, Sist. Julio Henriques: 33. 1949. *Biota orientalis* (L.) Endl.Syn. Conifer. 47. 1847; Bornm in Engler Bot. Jahrb. 44: 246. 1934; FBH. 3. 1977. *Thuja orientalis* Linn. Sp. Pl. 1002. 1753, ed. 22: 1422, 1763; Raizada & Sahni, Living Ind. Gymno. Ind. For. Rec. (n.s.) Botany 5(2): 144. t.XIII. f.3. 1960; Dallimore & Jackson, Hbk. of Conif. & Ginkgo. rev. Harrison ed.4, 612. 1966; Keith & Rushforth, Conifers. 192. 1987; Sahni, Gymno. Ind. & Adj. Countr. 110. t.26. f.2. 1990. Family Cupressaceae. CHINESE ARBORVITAE, PEACOCK FEATHERS. Vern.: Mor Pankhi (Figure 9).



Figure 9: *Platycladus orientalis (L.) Franco,* syn. *Biota orientalis* (L.) Endl.; *Thuja orientalis* L. CHINESE ARBORVITAE, PEACOCK FEATHERS. **Vern.:** Mor Pankhi, Vidya.

It is a bush or a small ornamental tree up to 9-15 m of dense habit, often branching into several stems from near the base or occasionally of columnar habit. **Bark** thin red brown. **Branches (shoots)** erect (a character which separates it from *Cypress*), often as long as the central stem. **Branchlets** erect, the secondary one arranged obliquely. **Leaves** persistent-scale-like and opposite, 1.5, mm without glands, smaller than those the other species, distinctly grooved on the back, triangular, ending in a blunt point, not pressed to the shoot, green on both surfaces, bearing minute stomata, giving off a slight resinous odour when bruised. **Strobilus** or **Cones** ovoid, fleshy and glaucous before ripening, with usually 6-8 scales, the lower one fertile, each with 2-3 wingless seeds. **Scales** are thick, woody, with a strong hooked or rolled boss near the apex, ultimately gaping widely and releasing the seeds. **Seeds** are ovoid, wingless. **Flowering and Fruiting:** May-October.

Specimens examined: Nihal, 5 May, 2013, Mahender. 463.

Habitat: It is mostly grown as an ornamental tree in gardens and near Government buildings. **Distribution**: Native of NW. China. It is cultivated in N. America and N-E. Asia. **India**: Cultivated throughout India. **Himachal Pradesh:** Kangra (throughout Kangra cultivated in gardens), Shimla (Rohru, Shimla). **Altitude:** 900-2800 m.

Economic and Ethnobotanic Uses: Seeds and roots yield an essential oil. Seeds also yield fatty oil. Leaves also yield an essential oil, which is used as a tonic, diuretic and antipyretic. Twigs and leaves are a good source of tannin. Wood is used for furniture, house building, fence posts, barrels and casks. It is a commonly cultivated species and is utilized for topiary in gardens. It is locally cultivated as an ornamental plant around Government and private institutions [2, 40,41].

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