

## Casuarina equisetifolia

ironwood, beaf-wood

L.

Casuarinaceae

### LOCAL NAMES

Amharic (arzelibanos,shewshewe); Arabic (casuarina); Bengali (jau,jhau,belaiti jhao); Burmese (pink-tinyu,tin-yu); Cantonese (sarve); Chinese (mu ma huang,pu tong mu ma huang); Creole (filao,pich pin); Creole Patois (yar); Dutch (Kazuarisboom); English (Australian beefwood,beach she-oak,whistling pine,beefwood tree,common ru,swamp she oak,casuarina,she oak,wild pepper,sea pine,coast she-oak,horsetail casuarina,horsetail tree,ironwood,Australian pine); Fijian (nokonoko); Filipino (agoho); French (bois de fer,filao,pin d'Australie,fialo,pich pin); German (Keulenbaum,eisenholz,Strand- Kasuarine); Hindi (vilayati saru,jungli jhao,jangli saru,savukku); Indonesian (aru,tjemara laut,cemara laut,ai samara,eru); Japanese (mokumao,ogasawara-matsu); Khmer (snga:w); Lao (Sino-Tibetan) (sôn tha lé,pè:k namz,pêk nam<sup>2</sup>,sôn th'ale); Malay (ru,ru / rhu laut,ru laut,aru); Pidgin English (yar); Sinhala (kasa ghas); Spanish (pino,pino d'Australia,Palo de buey); Swahili (moinga,mvinje); Tamil (chouk sabuku,savukku); Thai (son-thale,ku); Tongan (toa); Trade name (beaf-wood,ironwood); Vietnamese (c[aa]y phi lao,duong,filao,phi-lao)

### BOTANIC DESCRIPTION

*Casuarina equisetifolia* is an evergreen, dioecious or monoecious tree 6-35 (60) m tall, with a finely branched crown. Crown shape initially conical but tends to flatten with age. Trunk straight, cylindrical, usually branchless for up to 10 m, up to 100 (max. 150) cm in diameter, occasionally with buttresses. Bark light greyish-brown, smooth on young trunks, rough, thick, furrowed and flaking into oblong pieces on older trees; inner bark reddish or deep dirty brown, astringent. The branchlets are deciduous, drooping, needlelike, terete but with prominent angular ribs, 23-38 cm x 0.5-1 mm, greyish-green, articles 5-8 mm long, glabrous to densely pubescent, dimorphic, either deciduous or persistent. Twigs deciduous, entirely green or green only at their tips.

The minute, reduced, toothlike leaves are in whorls of 7-8 per node.

Flowers unisexual; perianth absent, replaced by 2 bracteoles. Male flowers in a terminal, simple, elongated spike, 7-40 mm long, borne in whorls with 7-11.5 whorls/cm of spike, with a single stamen. Female inflorescence on a short lateral branchlet, cylindrical, cone-shaped or globose, 10-24 x 9-13 mm; bracteoles more acute, more or less protruding from the surface of the cone.

Infructescence a woody, conelike structure. Fruit a grey or yellow-brown winged nut (samara). Seed solitary.

*Casuarina* is from the Malay word 'kasuari', from the supposed resemblance of the twigs to the plumage of the cassowary bird. One of the common names of *Casuarina* species, 'she-oak', widely used in Australia, refers to the attractive wood pattern of large lines or rays similar to oak but weaker.

The specific name is derived from the Latin 'equinus', pertaining to horses, and 'folium', a leaf, in reference to the fine, drooping twigs, which are reminiscent of coarse horse hair.

### BIOLOGY

*C. equisetifolia* is wind pollinated. Trees are mostly monoecious. Female cones mature about 18-20 weeks after anthesis and open shortly after this, releasing small samara. Fruit on a tree does not all mature at the same time, often presenting a problem for seed collection. In cultivation, *C. equisetifolia* hybridizes with *C. glauca* and *C. junghuhniana*.



Close up of fruit and foliage in paper mill plantation, Shimoga, Karnataka, India (Anthony Simons)



Young trees at Kure Maui, Hawaii (Forest & Kim Starr)



Hedge at Kahului Maui, Hawaii (Forest & Kim Starr)

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## ECOLOGY

The climate in its natural range is semi-arid to subhumid. In most regions there is a distinct dry period of 4-6 months, although this seasonality decreases towards the equator in Southeast Asia and in the southern parts of its range in Australia.

*C. equisetifolia* is commonly confined to a narrow strip adjacent to sandy coasts, rarely extending inland to lower hills, as in Fiji. Found on sand dunes, in sands alongside estuaries and behind fore-dunes and gentle slopes near the sea. It may be at the leading edge of dune vegetation, subject to salt spray and inundation with seawater at extremely high tides.

*C. equisetifolia* may be the only woody species growing over a ground cover of dune grasses and salt-tolerant broadleaved herbs; it can also be part of a richer association of trees and shrubs collectively termed the Indo-Pacific strand flora.

## BIOPHYSICAL LIMITS

Altitude: 0-1 400 m, Mean annual temperature: 10-35 deg. C, Mean annual rainfall: 200-3 500 mm

Soil type: Soils are invariably well-drained and rather coarse textured, principally sands and sand loams. The species tolerates both calcareous and slightly alkaline soils but is intolerant of prolonged waterlogging and may fail on poor sands where the subsoil moisture conditions are unsatisfactory.

## DOCUMENTED SPECIES DISTRIBUTION

- Native: Australia, Bangladesh, Brunei, Cambodia, Fiji, Indonesia, Malaysia, New Zealand, Papua New Guinea, Philippines, Samoa, Solomon Islands, Thailand, Tonga, Vanuatu, Vietnam
- Exotic: Antigua and Barbuda, Bahamas, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, China, Congo, Cote d'Ivoire, Cuba, Democratic Republic of Congo, Djibouti, Dominica, Dominican Republic, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Grenada, Guadeloupe, Guinea, Guinea-Bissau, Haiti, India, Israel, Jamaica, Kenya, Liberia, Madagascar, Mali, Martinique, Mauritania, Montserrat, Myanmar, Netherlands Antilles, Niger, Nigeria, Pakistan, Puerto Rico, Senegal, Sierra Leone, Somalia, South Africa, Sri Lanka, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Sudan, Tanzania, Togo, Trinidad and Tobago, Uganda, United States of America, Virgin Islands (US), Zanzibar



The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species can not be planted in other countries than those depicted. Since

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some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

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### PRODUCTS

**Fuel:** The highly regarded wood ignites readily even when green, and ashes retain heat for long periods. It has been called 'the best firewood in the world' and also produces high-quality charcoal. Calorific value of the wood is 5000 kcal/kg and that of the charcoal exceeds 7 000 kcal/kg. It has been used for both domestic and industrial fuel such as for railroad locomotives. In Asia, leaf litter from plantations is often removed to be used as fuel.

**Fibre:** The wood is used to produce paper pulp using neutral sulphate and semi-chemical processes, and as a raw material for rayon fibres.

**Timber:** *C. equisetifolia* yields a heavy hardwood with an air-density of 900-1000 kg/cubic m. Heartwood is pale red, pale brown to dark red-brown, moderately to sharply differentiated from the sapwood, which is yellowish or pale yellow-brown with a pink tinge. Grain is straight, slightly interlocked or wavy; texture fine to moderately fine and even. Shrinkage is moderate to very high, and in the latter case the wood is difficult to season due to severe warping and checking. Wood is hard to very hard and strong. The heartwood is highly resistant to pressure treatment, but sapwood is amenable to such treatment. Heartwood is also resistant to dry-wood termites. On sawn timber, the rays are prominent on radial faces. Uses include house posts, rafters, electric poles, tool handles, oars, wagon wheels and mine props.

**Tannin or dyestuff:** The bark contains 6-18% tannin and has been used extensively in Madagascar for tanning purposes. It penetrates the hide quickly and furnishes swollen, pliant, soft leather of pale reddish-brown colour.

**Medicine:** Root extracts are used for medical treatment of dysentery, diarrhoea and stomach-ache. In West Malaysia, a decoction of the twigs is used for treating swelling and the powdered bark is used for treating pimples on the face.

### SERVICES

**Erosion control:** Since it is salt tolerant and grows in sand, *C. equisetifolia* is used to control erosion along coastlines, estuaries, riverbanks and waterways. In Sarawak, Indonesia the species is protected because of its importance in controlling coastal erosion.

**Shade or shelter:** Many areas where the species naturally occurs are susceptible to tropical cyclones or typhoons, and its general tolerance to strong winds has encouraged its use in protective planting. The abundance of highly branched twigs absorbs wind energy amazingly well. In areas with hot, dry winds the tree protects crops and animals herds. In South China, an estimated 1 million hectares has been established in shelterbelts along the coastal dunes.

**Reclamation:** Grows vigorously on barren, polluted sites and thrives in deep sandy soils. Colonizes sterile tin tailings.

**Nitrogen fixing:** Root nodules containing the actinorhizal symbiont *Frankia* enable *C. equisetifolia* to fix atmospheric nitrogen. These root nodules can be prolific.

**Soil improver:** *C. equisetifolia* possesses proteoid roots and forms associations with vesicular arbuscular mycorrhizae.

**Ornamental:** Grown as ornamental along streets and seashores.

**Boundary or barrier or support:** It is remarkably suited for boundary planting as it does not intercept much of the incoming solar radiation and yields substantial quantities of green leaf manure on lopping besides other products.

**Intercropping:** With high productivity and properties that enhance soil fertility, *C. equisetifolia* shows promise as an agroforestry species for arid and semi-arid areas. Experiments at Prabhunagar, India, showed citrus trees grew larger under *C. equisetifolia* than in pure stands.

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### TREE MANAGEMENT

A planting density of 2 500 stems/ha is commonly used but some farmers plant up to 8 000-10 000 stems/ha when fuelwood and small poles are the required product. *C. equisetifolia* is a poor self-pruner. Pruning is necessary up to 2 m to make plantations accessible for maintenance. *C. equisetifolia* is not fire resistant and protection is necessary. It coppices only to a limited extent and best results are obtained when cut young. Timely thinning is essential as *Casuarina* species trees demand light. For timber production, an intermediate thinning will be required for stems to develop. Young trees are susceptible to competition from weeds, especially grasses. They are susceptible to drought until their roots reach the groundwater table, which may take up to 2-3 years after planting.

*C. equisetifolia* has a life span of 40-50 years and displays fast early growth. Under favourable conditions, early growth rates are about 2 m/year in height and the trees have good form in cultivation. On favourable sites, it can yield an annual increment of 15 cubic m/ha of wood in 10 years. In India, plantations using 1 x 1 m or 2 x 2 m spacing on 6-15 year rotations yield 50-200 t/ha. Dry weight per tree ranges from 15 to 25 kg at 3 years of age, depending on site quality. In South China, where an estimated 1 million hectares in shelterbelts along the coastal dunes have been established since 1954, heights of 7-8 m and diameters of 5-7 cm are achieved in about 4 years. The rotation period ranges from 4-5 years for fuelwood and 10-15 years for poles. Mean annual increments usually fall in the range of 4-5 cubic m/ha per year.

In Asia, leaf litter from plantations is often removed as fuel and this draws heavily upon soil phosphorus and potassium reserves. This can result in reduced yield in the subsequent rotation.

### GERMPLASM MANAGEMENT

Storage behaviour is orthodox. Viability can be maintained for several years in hermetic storage at 3 deg. C with 5-9% mc. There are about 26000 seeds/kg but viability is often low, even for fresh seed, averaging 50%.

### PESTS AND DISEASES

*C. equisetifolia* is only rarely attacked by diseases and pests, unless if grown under unfavourable conditions. Infected trees exhibit symptoms of foliar wilt and cracking of the bark where blisters develop, enclosing a black, powdery mass of spores. Bacterial wilt caused by *Pseudomonas solanacearum*, characterized by yellowing of the foliage followed by wilting and death, has been reported in India and China. Pruning may allow infection of fungal pathogens, especially *Trichosporium vesiculosum* and *Formes lucidus*. As in other actinorhizal plants, endomycorrhizal (VAM) infection occurs easily.

Insect pests include casuarina tussock moth, *Lymantria xyliana*, white-spotted long-horn beetle, *Anoplophora macularia*, and cotton locust, *Chondracis rosea*. Ants attack fresh seeds. The wood borers *Zeuzera* spp. and *Hypsiptla robusta* are known to cause severe damage to the wood.

For disease control, lopping and pruning of branches should be stopped to prevent primary establishment of disease. Diseased trees should be removed as early as possible and spread of the disease checked by making trenches around groups of diseased trees to avoid root contact.

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**SUGGESTED CITATION**

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