

Shorea robusta

sal

Gaertn. f.

Dipterocarpaceae

LOCAL NAMES

Bengali (sal,shal,sakhu); English (sal); French (damar de l'Inde); German (salharzbaum,salbaum); Hindi (borsal,hal,sagua,sakhu,sakhwa,sal,shal); Nepali (agrakh,sakhua,sal,sakwa); Sanskrit (shal); Tamil (kungiliyam (resin)); Trade name (sal)

BOTANIC DESCRIPTION

Shorea robusta is a large, deciduous tree up to 50 m tall and with a dbh of 5 m; these are exceptional sizes, and under normal conditions *S. robusta* trees attain a height of about 18-32 m and girths of 1.5-2 m; bole is clean, straight and cylindrical, but often bearing epicormic branches; crown is spreading and spherical. Bark dark brown and thick, with longitudinal fissures deep in poles, becoming shallow in mature trees; provides effective protection against fire. The tree develops a long taproot at a very young age.

Leaves simple, shiny, glabrous, about 10-25 cm long and broadly oval at the base, with the apex tapering into a long point; new leaves reddish, soon becoming delicate green.

Flowers yellowish-white, arranged in large terminal or axillary racemose panicles.

Fruit at full size about 1.3-1.5 cm long and 1 cm in diameter; it is surrounded by segments of the calyx enlarged into 5 rather unequal wings about 5-7.5 cm long.

BIOLOGY

S. robusta is a hermaphroditic, self-incompatible species. Pollen vectors in its natural habitat are insects from the family Thysanoptera. Heavy flowering of the tropical timber genus *Shorea* has usually correlated with the previous drought period. Beginning at about age 15, *S. robusta* bears fruit regularly every 2 years or so, and a good seed-bearing year can be expected every 3-5 years. Major seed dispersal agents include wind and water.



Shorea robusta (Uma Shankar)



Leaves of *shorea robusta* for making hats in southern Nepal. (Martien Gelens)



Harvesting - Leaves collected and used to make lacquered bowls. (Doug Maguire, Oregon State University, www.forestryimages.org)

ECOLOGY

Of the 2 factors of habitat, climate and soil, the former decides the general distribution of *S. robusta*; among the climatic factors, rainfall is by far the most important. Annual precipitation normally comes with a dry season lasting 4-8 months (monsoon climate). At higher elevations, *S. robusta* can be damaged by frost.

S. robusta occurs in both deciduous dry and moist forests and in evergreen moist forest. It accounts for about 14% of the total forest area in India. For example, southwest Bengal harbours luxuriant *S. robusta* forests. Fire is normally responsible for its frequent occurrence in pure stands or as the dominant species of mixed stands, as *S. robusta* is better equipped to survive conflagrations than other tree species.

BIOPHYSICAL LIMITS

Altitude: 100-1500 m, Mean annual temperature: (min. 1-7) 22-27 (max. 34-47) deg. C, Mean annual rainfall: 1000-3000 (max. 6600) mm

Soil type: *S. robusta* flourishes best in deep, well-drained, moist, slightly acid sandy to clayey soils. It does not tolerate waterlogging. The most favourable soil is a moist sandy loam with good subsoil drainage. Availability of soil moisture is an important factor determining the occurrence of *S. robusta*.

DOCUMENTED SPECIES DISTRIBUTION

Native: India, Myanmar, Nepal

Exotic:



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

PRODUCTS

Food: In India seeds are boiled into a porridge with flowers of *Bassia latifolia* and fruits of *Dolichos biflorus*. In Madras, India, seeds are ground into a coarse flour used to make bread, and the plant is used as a famine food. The chemical composition of the seeds consists of 10.8% water, 8% protein, 62.7% carbohydrate, 14.8% oil, 1.4% fibre and 2.3% ash. *S. robusta* butter, used in cooking, is derived from the seeds. A de-fatted kernel powder, popularly known as sal seed cake, contains about 50% starch, in addition to proteins, tannins and minerals. The physico-chemical property of the starch can be exploited for preparing canned food products.

Fodder: In India, *S. robusta* is lopped for fodder, but the leaf fodder is considered to be of medium to poor quality. The oil cake, though rich in tannins (5-8%), has been used without detrimental effects in concentrates for cattle in proportions of up to 20%. As the protein remains completely undigested, the oil cake yields only energy. Salseed cake can also constitute up to 10% of poultry and pig rations without affecting the performance of these animals. The leaves can be used as roughage for cattle and are fed to *Antheraea mylitta*, a tasar silk-producing worm.

Lipids: *S. robusta* seed oil fat has become a significant foreign exchange earner for India.

Timber: The dark, reddish brown, hard and heavy heartwood (specific gravity of 0.83-0.93 cm³) is very durable and highly resistant to termite attack; grain is strongly spiralled and rather coarsely structured; seasoning also presents problems. Wood is easy to saw, but because of its high resin content, it is difficult to plane and turn; it has a tendency to split when nails are driven into it.

This important Indian hardwood is especially well suited for structures subject to heavy stress in house construction, hydraulic engineering, ships and railway cars. It is also used for poles, railway ties and posts, simple interior finishing such as window frames and floors, and many other applications. For making household or agricultural implements, *S. robusta* coppice shoots are used.

Other products: *S. robusta* leaves are widely used for making leaf plates and cups for both home use and sale to sal plate factories.

SERVICES

Intercropping: In Assam, India, artificial regeneration of *S. robusta* is practised in combination with crops such as upland rice, maize, sesame and mustard. Good results have also been achieved with mixed plantations in which *S. robusta* is cultivated together with *Tectona grandis*.

TREE MANAGEMENT

Young plants grow quickly, attaining top heights of up to 6 m after 6 years. The 1st thinning is usually performed after 5 years, and thereafter the trees are thinned every 5-10 years. Rotations of 30-40 years are used when coppice regeneration is practised, and 80-160 years for high forest regeneration. A species that requires a lot of light, *S. robusta* coppices well. Both coppice regeneration and planting of seedlings are used in plantation systems. It is also ideally used for growing under taungya systems.

GERMPLASM MANAGEMENT

Storage behaviour is recalcitrant; viability is lost within 2 weeks in open storage at room temperature; 10% germination on desiccation at 33-36 deg. C to 9.6% mc. There are about 400-1000 seeds/kg.

PESTS AND DISEASES

S. robusta is beset by a number of pests and diseases. Among the insect pests in India, *Hoplocerambyx spinicornis* is the most destructive. Its larvae tunnel through the bark, sapwood and finally to the heartwood, causing death of the tree. The population of the pest keeps building up and if not checked may assume an epidemic level. Other insect pests include *Diacavus furtivus* and *Xyleborus* spp. The major fungal diseases include those caused by *Polyporus shorea* and *Polyporus gilvus*. The semi-parasite *Loranthus scurrula* can also cause increment losses.

FURTHER READING

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SUGGESTED CITATION

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