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REVIEW ARTICLE

THESPESIA POPULNEA – A MULTIPURPOSE TREE SPECIES

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ABSTRACT

Thespesia populnea is a valued multipurpose tree species grown in India especially by the rural coastal population. It is a timber of great utility, being used for furniture, agricultural implements and small canoes. It is an easy timber to saw and work and can be brought to a smooth surface and also takes a high polish. The wood is highly valued because it does not split. The wood is highly resistant to dry wood termites. The problem with this farmer friendly tree species is that it grows with twists and turns and therefore, timber of good length is not generally available, limiting its market potential. To address this issue, ICFRE-Institute of Forest Genetics and Tree Breeding, Coimbatore, India initiated a systematic tree improvement programme since 2011, conducted exhaustive field surveys, selected 139 crook free plus trees from the southern states, and assembled them in a Clonal Multiplication Area (CMA). Multi-location clonal trials established using the plantlets derived from this CMA are in various stages of evaluation for release of crook free superior clones. Apart from the utility as timber, this species yields fodder relished by cattle. It is also grown in agroforestry as standard for pepper. Wood yields dye and tannin. Most of the plant parts are being used in various medicines. It is also suitable for paper pulp. A detailed review of this valuable multipurpose tree species is presented in this paper.

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INTRODUCTION

Thespesia populnea (L.) Soland ex Correa is a small evergreen tree that averages 6–12 m in height with a short, often crooked stem, and a broad, dense crown. It is commonly referred as Portia Tree. The name Thespesia is derived from the Greek word thespesios, which means divine or sacred. In ancient times, trees were planted around places of worship. In Tahiti, the tree was associated with the God of prayer and chanting. Branches were attached to canoe masts as a token of peace and the leaves were used by priests in ceremonial offerings. In English it is called as Indian Tulip Tree, Portia Tree, Cork Tree, Umbrella Tree or Pacific Rosewood. Hindi: Gajahanda, Paras-pipal, Parsippu, Bhandi; Sanskrit: Parisha; Tamil: Puvarasam, Puvarassu, Poris, Purasia, Pursa, Porsung, Kallal, Karvarachu; Telugu: Gangareni, Gangarava, Gangaravi, Gangaregu, Galgaiovi; Malayalam: Poovarasu, Sheelanathi, Pupparrutti, Chandamaram; Kannada: Asha, Hurvarshi, Huvarsi, Bugari, Arasi, Hoovarasu

Taxonomical Classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Malvales
Family: Malvaceae
Genus: Thespesia
Species: populnea

Distribution and Environmental Conditions

World: The species has been planted throughout the tropics and is naturalized in tropical climates throughout the world. It is a typical coastal species of South Asia, Africa and the Pacific Islands. Naturalized in Florida and West Indies. Cultivated occasionally in Central and South America.

India: It is a common species in the coastal tracts of the Indian Peninsula and in mangrove swamps. It is especially common and perhaps wild in South Kanara, Malabar, deltas of Godavari and Mahanadi and in Cuttack. It is also found in the Sunderbans of West Bengal and in Andamans. It is more often cultivated as an avenue tree in cities and towns near sea coast such as Kolkata, Mumbai and Chennai. It has been successfully grown as an avenue tree around Bangalore. It has also been extensively planted in Chandigarh.

Native Range: Coastal areas of Indian and Pacific Oceans from east Africa and India to mainland South-east Asia, Indonesia and the Philippines. In the Pacific it grows from Papua New Guinea and the northern coast of Australia through the Solomons, Vanuatu and Fiji. In Micronesia it grows in Guam and the Mariana Islands, the Gilbert Islands and in Palau, Yap, Chuuk, Pohnpei, Kosrae and the Marshalls. In Polynesia it is found in Tonga, Samoa, Niue, the Cook Islands, Tahiti, the Society Islands, the Tuamotos and the Marquesas. It is

documented on the Hawaiian Islands also. In India it occurs in the littoral forests of Andamans and Sunderbans (4A/L₁).

In Andamans, it occurs in the third storey in association with *Hibiscus tiliaceus* and *Pandanus tectorius*, the overwood consisting mainly of *Manilkara littoralis* with species like *Pongamia pinnata*, *Erythrina variegata*, *Calophyllum inophyllum* and *Terminalia cattappa* in the second storey. In Sunderbans, it forms the overwood in association with *Hibiscus tiliaceus*, *Erythrina variegata*, *Trewia nudiflora*, *Tamarix troupitii* and *Vitex* spp.

Botanical Descriptions: It is an evergreen tree (6-12 m in average height) with a broad dense crown with often crooked stem. The tree grows in short twists and turns with numerous limbs, therefore lumber is only found in short lengths. Clear bole around 2 to 2.5 m, Girth (at breast height) around 0.6 to 1.2 m. It has fissured gray / dark brown bark, and a dense crown of green glossy heart shaped leaves. It is easily recognized by its large yellow flowers with purple centre, its heart shaped leaves and the turban shaped capsules. Leaves are glossy, green heart shaped resembling those of poplar. 8-15 cm X 6-10 cm. Broadly ovate with the lower corners rounded off, cordate at the base, acuminate, entire. Flowers are yellow, bell shaped, hibiscus type flowers, 5 to 7.5 cm in length with five overlapping broad, rounded petals. Axillary, solitary or two together, bisexual. Maroon / purple spot can be observed at the base of each petal with star shaped hairs on outer surface. The yellow flowers turn dark red, purple or pink as the day progresses. Fruits, five celled globose capsules 2.5 to 5 cm in diameter, flattened, covered with minute peltate scales with disc like persistent calyx at the base, black when ripe. The brown, hairy seeds are about 1 cm (0.4 in) long and 0.6 cm (0.2 in) broad. Seeds are blown short distances by wind but are more likely to be dispersed by water. There are between 3500 and 6700 seeds/kg (Friday and Okano, 2006).

Reproductive Biology and Breeding System: Generally propagated by seed, although it can also be propagated by stem and root cuttings and by air-layering. Seeds are usually plentiful and initial growth is fast. Flowers more or less throughout the year, mainly during December to March. Mature fruits may usually found on trees year round, mainly during March to May. Mating system is open pollination and entomophily has been reported. Chromosome number $2n = 26$. For stem cuttings 3000 ppm of IBA was found to be superior for rooting (Warriar *et al.*, 2021).

Genetics and Tree Improvement: The species has been identified as a priority species for further genetic research and conservation by South Pacific Regional Initiative on Forest Genetic Resources (SPRIG), CSIRO Forestry and Forestry Products Canberra, Australia. Systematic tree improvement programme has been initiated in *T. populnea* at IFGTB since 2011 and Plus Trees numbering 139 have been selected from Tamil Nadu, Kerala and Puducherry with straight stem and vigour. Among them 86 rooted clones were propagated through rooting of cuttings and a Clonal Multiplication Area was established at Panampully Research Centre of IFGTB near Palakkad, Kerala. Three clonal trials have been established to select the most promising clones for large scale cultivation. Mahendran *et al.* 2018 from Tamil Nadu Agricultural University studied the genetic variability of 20 half-sib progenies of *Thespesia populnea* and identified three superior progenies for coastal saline soil.

Seed Collection, Processing and Nursery Techniques: Fruits are available nearly round the year. Fruits and seeds buoyant, adapted to long-distance dispersal by tides and ocean currents. 1 to 11 seeds per fruit have been reported (mean 5.7 ± 0.4 seeds per fruit). Fertile seeds/fruit may range from 3 to 5. Germination percent varies from 65 to 80%. Germination begins about 8 days after sowing (may extend to 10 weeks) and the germination is epigeal. Data are lacking on seed storage requirements. However, in general it is reported that short-term storage in sealed containers has not been detrimental. Seed may remain viable for 24 months. Refrigeration in sealed containers is recommended for long term storage. Germination can be hastened by

nicking / sand paper rubbing followed by soaking the seeds overnight in cool water. Scarifying the seed coat for 20-60 minutes using 95% sulfuric acid followed by 24 hours soaking in tap water was also proved to improve germination. The temperature of 30°C conferred maximum germination. (Camara *et al.* 2009). Seeds may be sown and lightly covered in fine sand, well-drained soil or potting mixture. Seeds are normally germinated in germination trays or beds and transplanted into nursery bags later. Seeds may be pre-germinated in moist towels also.

Silviculture, Plantations and Management: Seeds may be sown in July. Seedlings are ready to be out planted when they reach 15 to 25 cm in height in about 12 to 16 weeks. Seedlings should be hardened off with reduced watering and exposure to full sunlight for 4 to 6 weeks before being out planted. Around 1 to 1.5 kg of seeds can be used for standard bed. Stump planting has been attempted, but not a successful method. Shoot or branch cuttings of up to 2 m length and 10 cm diameter have been used, although smaller cuttings (30 cm long) are preferred and observed to produce healthier trees. It is a slow coppicer.

Agroforestry Practices: Since ancient times, the tree has been planted in homegardens. It is used to stabilize bunds of ponds for prawn cultivation. The species has been used as a living fence post also. It is an excellent windbreak in coastal areas due to its dense crown and tolerance to wind and salt spray. It is being used as a standard for pepper vines and vanilla plants.

Growth, Yield and Economics: Height growth: 0.6 to 1.5 m per year in general for the first few years. At an age of 7 to 10 years, growth in height slows down. Stem diameter growth ranges from 1 to 3 cm per year. Regarded as a fast-growing species. Thrives well on sandy coastal soils, but also grown on volcanic soils, soils derived from limestone and rocky headlands. It does not grow well in upland acidic clays. It comes up in sands, sandy loams, loams, sandy clay loams, clays, clay loams and sandy clays. Tolerates occasional tidal inundation and saline soils. Preferred soil acidity: 6.0 to 7.4. Once established it develops a deep root system and tolerate long periods of drought. It prefers full sun. It is cold sensitive, restricted to areas with minimum temperatures above 1.7°C but can stand mild frosts. Reported that it shifts into the more efficient C₄ photosynthesis under saline conditions. Pure plantations of this species are not reported. Tamil Nadu Forest Department has raised *Thespesia* in mixed plantations at Thangachimadam, Pamban (Rameswaram), Kumbakonam, Nazareth range (Tiruchendur) and Tirupur. This species can be harvested from 15 years for timber purpose; recommended harvesting period for pulp and paper purpose is 5th year. The average production is 150 tonnes per hectare. (Tntreepedia, 2023; Palanikumaran *et al.* 2017) In India, *Thespesia populnea* wood may fetch up to Rs 2,200/- per cubic foot.

Important Insect-pests and Diseases: It is a host to several important pests of cotton including the cotton stainer bug (*Dysdercus* sp.) the cotton boll weevil (*Anthonomus grandis*), *Pyroderces simplex* and the Indian dusky cotton bug (*Oxycarenus laetus*). In adult trees, the fungus *Fomes pachyphloeus* causes heart rot. The tree is also susceptible to fungal stem and root rot caused by *Phellinus noxius*. Fungus, *Scytalidium dimidiatum* is reported to cause Dieback in Oman. Bacterium, *Xanthomonas campestris* pv. *Thespesiae* causes leaf spot and blight disease. *Phomopsis thesipesiae* causes leaf spot. Spiralling whitefly, *Aleurodicus dispersus*, were observed infesting the leaves.

Wood Properties/Utilization: It is a timber of great local utility, being used for furniture, agricultural implements and small canoes. It is an easy timber to saw and work and can be brought to a smooth surface and also takes a high polish. The wood is highly valued in Travancore area, Kerala because it does not split. Highly resistant to dry wood termites. The wood can be carved into bowls, tools and figures. Timber is in demand for turnery and toys. It is also suitable for helms, tool handles, shuttles and other textile accessories. Wood is used for food containers, slit drums and cabinetry. The timber is

very durable under water and popular for boat building. It is also used as fuelwood. Density: 770 kg/m³, Specific gravity: 0.55 to 0.89. Weight: 113, Strength as a beam: 122, Stiffness as a beam: 92, Suitability as a post: 101, Shock resisting ability: 182, Retention of shape: 78, Shear: 131, Hardness: 124, Refractoriness: 91, Nail or screw holding property: 109. (Comparative suitability as a timber with teak taken as 100). The wood does not offer any difficulty in seasoning provided it is protected against too rapid drying. Shock resisting ability: 182, Shear: 131 (Teak 100). The bark thickness is 0.3 to 0.8 cm. Chemical composition of wood samples are ash: 1.04%, lignin: 28.45%, hollocellulose: 69.86% and anatomical characteristics of fibres are Fibre Length: 682.185 µm, Fibre Diameter: 37.57 µm, Fibre Wall Thickness: 7.63 µm, Fibre Lumen Width: 22.06 µm (Palanikumar *et al.* 2017).

Medicinal Uses: Extracts from roots are applied externally for scabies, psoriasis and related skin diseases. Heart wood used in indigenous medicine for skin diseases. In Mauritius, the bark is described as depurative and as a cure for dysentery and Haemorrhoids. Decoction of the bark is used for washing skin diseases. Ground bark mixed with coconut oil is also applied for skin diseases. Bark extracts have been reported to possess antioxidant and hepatoprotective activity. Leaf extracts are applied on inflamed and swollen joints. Cytotoxic activity of methanol extracts of leaves has been reported on human leukaemia cells. Bioassay results have showed that the extracts of flowers have anti-bacterial activity. Flavonoids have been isolated from the ether and ethyl acetate fractions of the ethanol extract of the flowers. Antihepatotoxic antisteroidogenic activities of flower extract have been reported. The fruit abounds in a viscid, yellow juice which the natives of south India use as an excellent application in psoriasis. It is also used to treat insect bites, gonorrhoea, ringworm, migraine, fistula, sprains and wart removal. Fruit extracts has wound healing properties also. Irular tribal community of Anaikkatty Hills, Kerala uses the seed extracts for prevention of pregnancy. Plant extracts have been reported to have significant anti-malarial activity.

Other Relevant Information: The wood yields a yellow dye which is used to dye wool in the east and south east Asia and the leaves are used to make a black dye. The bark contains high levels of tannins and has been used for tanning leather. Dark red resin exudes from the bark. Seeds yield lamp oil. Seed oil is reported to contain palmitic, oleic and linoleic acids. It is reported that it shifts into the more efficient C₄ photosynthesis under saline conditions. Therefore, the species can be effectively utilized as carbon sink in saline soils. Leaf extracts (10% w/v) of the species caused 100 per cent mortality on *Meloidogyne javanica* larvae causing root-knot disease on tobacco. Ether extracts of the fruit pericarps of *T. populnea* exhibited antifeedant and antibiosis activity against spotted bollworm, *Earias vittella*. The flower buds and young leaves are edible. Leaves are used as green manure. Cork is made from inner bark. The tough fibrous bark can be made into ropes. The bark is also used to caulk boats. It has been identified as a suitable woody plant species for site rehabilitation in Tsunami affected areas in Sri Lanka. In Ghana, food products namely 'Abolo' (Baked or steamed maize dough) and 'Apitsi' (Mixture of baked ripe plantain and maize flour) are baked and sold in *Thespesia populnea* leaves. *T. populnea* bark appears to be a promising candidate for improving memory and it would be worthwhile to explore the potential of this plant in the management of Alzheimer patients (Vasudevan and Parle, 2006). This species has high potential for reforestation and recovery of degraded areas, particularly in coastal regions, because of its tolerance of saline conditions. *Thespesia* seeds have 20% oil and can be transformed into biodiesel with a high yield (98.1%) under an optimised set of transesterification conditions. (Rashid *et al.* 2014).

Major Problem: The major problem with *T populnea* is that the stem is often crooked. It grows in short twists and turns and lumber of good length is not generally available, limiting its market potential. To address this problem a systematic tree improvement programme is underway at the ICFRE-Institute of Forest Genetics and Tree Breeding, Coimbatore, India. Clonal trials with crook free trees are

being evaluated for release of superior and stable clones of this valuable tree species.

CONCLUSION

From this detailed review, it is clear that *T. populnea* is an underutilized tree species which has a market potential to be used as a secondary timber species. Though research on its medicinal properties have been widely undertaken, research on tree improvement is scanty. Research programmes to evolve crook free trees are warranted.

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