Leucaena leucocephala

Scientific name

*Leucaena leucocephala* (Lam.) De Wit

Subordinate taxa

*Leucaena leucocephala* (Lam.) de Wit subsp. *glabrata* (Rose) Zárate

*Leucaena leucocephala* (Lam.) de Wit subsp. *ixtahuacana* C.E. Hughes

*Leucaena leucocephala* (Lam.) de Wit subsp. *leucocephala*

Synonyms

*Acacia leucocephala* (Lam.) Link

*Leucaena glauca* Benth.

*Mimosa glauca* sensu L.

*Mimosa leucocephala* Lam.

Family/tribe

Family: *Fabaceae* (alt. *Leguminosae*)

subfamily: *Mimosoideae*

tribe: *Mimoseae*. Also placed in: *Mimosaceae*.

Common names

guage (Mexico); wild tamarind (Corozal, Belize); lead tree (Florida); lamtoro (Indonesia, Malaysia, Papua New Guinea); ipil ipil (Philippines); jumby bean (Bahamas); false koa, koa haole (Hawaii); tangantangan, tangan tangan, talantayan (Guam, Marshall Islands); taltangan, gantinituyuan tangantangan (Yap); tuhungantuhangan, robbohtin (Kosrae); telentund (Palau); lopa samoa (American Samoa); fua pepe (American Samoa and Samoa); lusina (Samoa); pepe (Niue and Samoa); nito (Cook Islands); siale mohemohe (Tonga); subabul (India); vaivai (Fiji); cassis (Vanuatu); te kaitetua (Kiribati); kay keo dâu (Vietnam).

Morphological description

Shrub or tree up to 18 m tall, forked when shrubby and branching strongly after coppicing, with greyish bark and prominent lenticels. Leaves bipinnate with 4-9 pairs of pinnae, variable in length up to 35 cm, with a large gland (up to 5 mm) at the base of the petiole; leaflets 11-22 pairs/pinna, 8-16 mm x 1-2 mm, acute. Flowers numerous, in globose heads with a diameter of 2-5 cm, stamens (10 per flower) and pistil 10 mm long, anthers pilose, dehiscing at dawn. Pod 14-26 cm x 1.5-2 cm, pendant, brown at maturity. Seeds 18-22 per pod, 6-10 mm long, brown.

Distribution

Native to and naturalised in:

*L. leucocephala* subsp. *leucocephala* occurs naturally in the Yucatan Peninsula and the Isthmus of Tehuantepec in southern Mexico, and is widely distributed (naturalised) throughout the tropics. Probably introduced into the Philippines in the 16th Century as a feed for ruminant livestock. Subsequently spread throughout Asia-Pacific region. Previously used in agroforestry but no longer commonly planted.

*L. leucocephala* subsp. *glabrata* is widely distributed throughout Mexico and Central America. Not possible to identify its natural range due to extensive cultivation over millennia. Commonly used in tropical agroforestry systems. Subspecies *ixtahuacana* Hughes occurs in a very restricted region of northern Guatemala and adjoining southern Mexico and has only recently been identified.

Uses/applications

Unripe pods and seeds of all subspecies have been used by the native inhabitants of Mexico and Central America as a food or medicine since ancient times. Very young shoots used as a food by villagers in Thailand.

Highly valued as ruminant forage and as a fuelwood by subsistence and semi-commercial farmers throughout southeast Asia and parts of central Asia and Africa.

Planted in hedgerow systems with grass for cattle production in northern Australia, and as a hedgerow species in parts of southeast Asia and Africa.

Used as a shade tree over coffee and cocoa. Grown in dense rows as a living fence and used to support vine crops such as pepper and passionfruit. The most commonly researched species for alley farming systems.

Has been used as a reclamation species following mining, but no longer used due to the weed risk.

Ecology

Soil requirements

In its native range, grows on shallow limestone soils, coastal sands and seasonally dry, self-mulching vertisol soils of pH 7.0-8.5. In exotic locations requires well-drained soils with pH (H₂O) above 5.5, or above 5.0 where aluminium saturation is very low. Intolerant of soils with low pH, low P, low Ca, high aluminium saturation, high salinity and waterlogging. Tolerant of moderate salinity and alkalinity.

Moisture
Prefers subhumid and humid climates of 650-1,500 mm and up to 3,000 mm annual rainfall and tolerates up to 7 months dry season. Does not tolerate waterlogged soils or extended periods of flooding (>3 weeks).

Temperature
Requires temperatures of 25-30°C for optimum growth. Growth ceases at 15-16°C. Light frosts will kill leaf. Very heavy frosts will kill stems back to ground level but will not kill mature plants.

Light
Grows readily to 50% PAR. Productive under mature coconuts in Vanuatu and Indonesia.

Reproductive development
All subspecies will flower and set seed throughout the year providing soil moisture and temperature are adequate. Subspecies *leucocephala* is particularly precocious and free seeding.

Defoliation
Extremely tolerant of regular defoliation by cutting or grazing once established. *L. leucocephala* growing on a poorly drained podsolic in southeast Queensland, Australia had a half-life of 23 years under regular grazing, but much longer life span can be expected when grown on more suitable soil types.

Fire
Mature plants are tolerant of fire, regrowing readily from burnt stumps. Fire can be used to reduce height of grazed hedgerows, although productivity in the subsequent year may be poor.

Agronomy
Guidelines for the establishment and management of sown pastures.

Establishment
Relatively slow to establish, particularly in competition with weed species. For best results plant on deep, well-drained soils with pH >5.5 and maintain a weed-free area of at least 2 m either side of the establishing plants. Seed must be scarified to break the impermeable testa. Previously, hot-water treatment was recommended but resulted in highly variable outcomes including reduced vigour and/or viability and uneven germination. Mechanical scarification, using coarse sandpaper (for small seed lots) or abrasive-lined rotating drum scarifiers, is now preferred. Specific rhizobium is required (eg. CB3060, TAL1145, LDK4).

Complete cultivation is recommended in extensive plantings. Planted into rows 4-9 m apart at seeding rates of 1.5-3.0 kg/ha. Post-plant herbicides such as bentazone and imazethapyr can be used to control weed seedlings in the rows. Rolling cultivators can be used to control very young weed seedlings and break soils crusts after emergence of leucaena seedlings.

Small areas can be planted using either seed or seedlings. Seedlings are normally raised in poly bags for plug planting at 3-4 months old. Seedlings can also be raised in beds and removed for planting as bare-rooted seedlings if 'topped and tailed'.

Fertiliser
Normally not fertilised under rain-grown conditions. Starter N and P may be used when establishing into depleted soils on cropping lands. *Leucaena* in Australia has occasionally responded strongly to added sulphur. On acid-infertile soils it is essential to add lime, P and K at planting and after each cut.

Compatibility (with other species)
Compatible with a range of grass species. Can be difficult to establish leucaena into existing grass pastures without complete grass control or clean cultivation. In the dry tropics, can be difficult to establish a grass into mature leucaena due predominantly to competition for moisture. Grass establishment can be particularly problematic on strongly self-mulching clay soils.

Companion species
Grasses: In sub-humid, tropical Australia, grown with buffel grass (*Cenchrus ciliaris*), green panic (*Panicum maximum var. trichoglane*), Rhodes grass (*Chloris gayana*) or bambatsi panic (*Panicum coloratum*). In Papua New Guinea and humid-tropical Australia, grown with pangola (*Digitaria eriantha* subsp. *decumbens*), humidicola (*Brachiaria humidicola*), signal (*B. decumbens*) or sabi grass (*Urochloa mosambicensis*).

Normally grown as a hedgerow with grasses or crops grown between hedgerows. Can be grown as a sole species as a protein bank.

Pests and diseases
Main insect pest is the psyllid, *Heteropsylla cubana*, a small aphid-like sucking insect that reduces production of all *L. leucocephala* cultivars and accessions. Psyllid population outbreaks are generally episodic, occurring when climatic conditions are conducive. In the humid tropics, outbreaks are most severe at the start and end of the wet season. Populations can be almost permanently high where moderate rainfall and temperatures occur throughout the year. Although all *L. leucocephala* accessions are susceptible, cv. Tarramba and some other subsp. *glabrata* accessions possess the ability to regrow rapidly following outbreaks. There is considerable genetic resistance to the psyllid in *L. collinsii*, *L. pallida*, certain accessions of *L. trichandra* and other species within *Leucaena*. 
A range of pathogenic fungi and insects occasionally attack *L. leucocephala*. Damping-off diseases caused by the fungal species *Pythium* or *Rhizoctonia* commonly kill newly emerged nursery and field-grown seedlings. The crown rot *Pirex subvinosus*, has caused death of irrigated *L. leucocephala* in northern Australia. The disease spreads about 1 m per year from the source of infection, and is exacerbated by waterlogged conditions and regular slashing of trees during the wet season or immediately following irrigation.

The soft scale (*Coccus longulus*) attacks the tall stems of *L. leucocephala* causing a reduction in productivity. The associated sooty mould that develops on the sugary exudates from the scale can cover the stems and temporarily kill under-storey grasses. Soft scale is generally an infrequent pest, with populations rarely building to cause economic damage.

Soil insects such as earwigs, scarab beetles, termites and cut worms can cause serious damage to emerging seedlings and should be controlled using insecticide baits.

Seed production can be reduced by the flower-eating larvae of the moth *Ithome lassula*, and by three species of seed-eating bruchid beetles of the *Acanthoscelides* genus and two of the *Stator* genus.

Spur-throated locusts (*Austracris guttulosa*) occasionally attack *L. leucocephala*, temporarily defoliating mature plants and killing seedlings during early establishment.

**Ability to spread**

Will not normally spread under grazing as cattle relish young seedlings. Some thickening up of grazed stands has occurred in eastern Australia where leucaena is left ungrazed during the growing season for provision of autumn feed.

**Weed potential**

Has considerable weed potential in ungrazed situations due to hardseededness and high rates of seed production. Readily colonises disturbed lands such as roadsides and stream banks, particularly where soils are limestone based. No weed potential under continuous grazing as trees rarely set seed and any seedlings that recruit are killed either by grazing or grass competition. Thickening up of hedgerows may occur where delayed grazing allows seed set and seedling recruitment. Weed potential is particularly severe for *L. leucocephala* subsp. *leucocephala*, as this subspecies seeds continuously and heavily throughout the year given sufficient soil moisture.

**Feeding value**

**Nutritive value**

*L. leucocephala* foliage is noted for its very high nutritive value for ruminant production. Typical values for the edible fraction are 55-70% digestibility, 3.4-5.9% N, 6% ether extract, 6-10% ash, 30-50% N-free extract, 0.8-1.9% Ca and 0.23-0.27% P. Na levels are generally below requirements for ruminants at 0.01-0.05%. Leaves also contain 2-6% condensed tannins (CT), phenolic compounds which bind and protect dietary protein from degradation in the rumen. Providing that the protein-CT complexes dissociate post-ruminally allowing N absorption in the lower gut, CTs have the potential to increase protein uptake.

**Palatability/acceptability**

*L. leucocephala* is highly palatable to most grazing animals, especially compared to other forage tree legumes such as *Calliandra calothyrsus* and *Gliricidia sepium*.

**Toxicity**

Contains mimosine, a non-protein amino acid that has antimitotic and depilatory effects on animals. Concentrations in young leaf can be as high as 12% and the edible fraction commonly contains 4-6% mimosine. Mimosine is acutely toxic to animals but is normally converted to 3-hydroxy-4(IH)-pyridone (DHP) upon ingestion. DHP is goitrogenic and, if not degraded, can result in low serum thyroxine levels, ulceration of the oesophagus and reticulo-rumen, excessive salivation, poor appetite and low liveweight gains, especially when the diet contains more than 30% leucaena. The anaerobic rumen bacteria, *Synergistes jonesii*, occur in most countries in the Americas and southeast Asia and completely detoxify DHP and its breakdown products. *Synergistes jonesii* was transferred to ruminant livestock in Australia in the mid 1980s and subsequently to Africa and China.

**Production potential**

**Dry matter**

Yields of forage vary with soil fertility, rainfall, altitude, density and cutting frequency from 1-15 t/ha/year. Leaf yield is maximised by cutting at 6-12 week intervals during the growing season. Yields in extensive hedgerow plantings in the dry tropics and subtropics generally range from 2-6 t/ha/year.

Very high yields (>15 t/ha/year) in southeast Asia and Hawaii, with plants 0.5-1.0 m apart in rows 1-3 m apart. Fuelwood yields compare favourably with the best tropical trees, with height increments of 3-5 m/year and wood increments of 20-60 m³/ha/year for arboreal varieties.

**Animal production**

Excellent growth rates of 1.26 kg/head/day for cattle grazing leucaena-buffel grass (*Cenchrus ciliaris*) pastures over a 6-month period were reported in Queensland, Australia, although growth rates are more commonly 250-300 kg/head/year (0.7-0.85 kg/head/day). Under irrigation in northwestern Australia, annual liveweight gains of up to 1,700 kg/ha/year have been recorded for cattle grazing at 6 head/ha.
Genetics/breeding

*L. leucocephala* is a highly self-compatible tetraploid (2n = 4x = 104) and has a relatively narrow genetic base. It is thought to have evolved as an amphidiploid between *L. pulverulenta* and *L. lanceolata*. *L. leucocephala* hybridises readily with the other tetraploid species *L. pallida*, *L. diversifolia* and *L. confertiflora*, and with the diploid species *L. esculenta*, *L. retusa*, *L. salvadorensis* and *L. shannonii*. Hybridisation with other diploid species of *Leucaena* is more difficult to achieve.

Seed production

In central Queensland, Australia (23ºS) peak flowering of subsp. *glabrata* occurs from February to April, although trees may not flower in their first year. Subsequent seed production is strongly moisture dependent and producers report minimal seed set in dry years. Seed yields of 250 kg/ha are common from mechanically harvested, dryland crops, but wide-spaced, manually harvested trees under irrigation can produce up to 2 t/ha. Where moisture and temperature are suitable, subsp. *glabrata* will flower throughout the year.

Herbicide effects

Post-emergence herbicides such as bentazone (post-emergence) and imazethapyr (post-planting) are commonly used in northern Australia. *L. leucocephala* can be controlled by basal bark application of herbicides containing 120 g/L picloram and 240 g/L triclopyr mixed with diesel.

Application of glyphosate to regrowth after slashing will kill trees, but repeat applications may be necessary.

Strengths

- Very high nutritive quality for ruminant livestock.
- Highly productive on suitable soils.
- Tolerant of prolonged dry periods and retains leaf into dry.
- Produces multiple products in a wide range of farming systems.

Limitations

- Poorly adapted to acid-infertile soils.
- Poor growth at low temperatures and is susceptible to frosting.
- Relatively weak in seedling stage and slow to establish.
- Mimosine and condensed tannins limit use for non-ruminant livestock.

Other comments

Selected references


Internet links

http://www.fao.org/ag/AGP/AGPC/doc/Publicat/Gutt-shel/x5556e06.htm
http://www.fao.org/ag/AGP/AGPC/doc/Publicat/Gutt-shel/x5556e06.htm
http://www.hort.purdue.edu/newcrop/duke_energy/Leucaena_leucocephala.html
http://www.worldagroforestry.org/Sites/TreeDBS/AFT/SpeciesInfo.cfm?SpID=1069
http://www.worldagroforestry.org/Sites/TreeDBS/Leucat/collection.htm

Cultivars

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Country/date released</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Tarramba’</td>
<td>Australia (1995)</td>
<td>Bred by the University of Hawaii from seed collected at 1,675 m altitude in Mexico as K636. Establishes more rapidly, and marginally more pyridine resistant and cool tolerant than ‘Peru’ and ‘Cunningham’. More arboreal in habit cf. ‘Cunningham’.</td>
</tr>
<tr>
<td>‘Cunningham’</td>
<td>Australia (1976)</td>
<td>Bred by CSIRO, Australia. An elite line selected from a F4 generation of the cross between cultivar Peru and CPI 18228 from Guatemala. More highly branched and 30% higher yielding than ‘Peru’, but similar in nutritive quality of leaf. Currently favoured in northern Australia where pyridine pressure is low and low temperatures do not restrict growth.</td>
</tr>
<tr>
<td>‘Peru’</td>
<td>Australia (1962)</td>
<td>Introduced from Argentina (although seed originally from Peru) by CSIRO as CPI 18614. More branching and higher yielding than the El Salvador cultivar. Well adapted to 750 mm rainfall zones where winter minimum temperatures are &gt;10ºC.</td>
</tr>
<tr>
<td>‘El Salvador’</td>
<td>Australia (1962)</td>
<td>Introduced from the University of Hawaii by CSIRO as CPI 18623. Taller and less branching than ‘Peru’, growing rapidly to 4 m and up to 15 m tall. Seedlings recruiting underneath the mature trees were grazed by cattle.</td>
</tr>
<tr>
<td>‘K8’</td>
<td>University of Hawaii</td>
<td>Arboreal accession promoted by the University of Hawaii through the 1960s to 1980s. Widely planted throughout the tropics. Badly affected by the psyllid insect.</td>
</tr>
<tr>
<td>‘K28’</td>
<td>University of Hawaii</td>
<td>Promoted by the University of Hawaii as a multipurpose accession prior to K636. Reported to perform marginally better than K636 in acid soils.</td>
</tr>
</tbody>
</table>
Promising accessions

<table>
<thead>
<tr>
<th>Promising accessions</th>
<th>Country</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS84</td>
<td>Hawaii, Florida, Australia and southeast Asia.</td>
<td>Similar in growth and psyllid/cool tolerance to K636 but slightly more branching in habit. High yielding in agronomic trials in Hawaii, Florida, and Australia.</td>
</tr>
<tr>
<td>OFI 117/92</td>
<td>Australia</td>
<td><em>L. leucocephala</em> subsp. <em>ixtahuacana</em>, similar in productivity to K636 and KS84 but with slightly higher psyllid resistance. Collected at 1,230 m altitude in Ixtahuacan, Guatemala.</td>
</tr>
<tr>
<td>OFI 32/88</td>
<td>Southeast Asia</td>
<td>High yielding in humid tropical low psyllid environments. Collected as an exotic accession from Haiti.</td>
</tr>
</tbody>
</table>


'Romelia' Colombia (1992) CIAT 21888 selected at La Romelia, Colombia, 2,700 mm annual rainfall, 1,400 m asl., soil pH 5.1, Al saturation 22%.
Severe psyllid damage to new shoots.