

Tropical Forages

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

Leucaena leucocephala: Basionym: *Acacia leucocephala* (Lam.) Link; *Acacia glauca* Willd.; *Leucaena glauca* auct.

subsp. *glabrata*: Basionym: *Leucaena glabrata* Rose

subsp. *leucocephala*: Basionym: *Mimosa leucocephala* Lam.

Family/tribe

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

subfamily: *Caesalpinioideae* (mimosoid clade*) tribe: *Mimoseae*.

* Azani, N. et al. [97 authors from 54 institutions] 2017. A new subfamily classification of the Leguminosae based on a taxonomically comprehensive phylogeny. *Taxon* **66**: 44–77.

Morphological description

Deep-rooted shrub or tree 2–6 (–20) m tall; form varies from shrubby and highly branched (ssp. *leucocephala*) to arborescent with a short clear bole to 5 m, upright angular branching and an open, rounded crown (ssp. *glabrata*); both subspecies coppice densely from basal buds. Branchlets pubescent, glabrous when old, with prominent brown lenticels. Bark mid grey-brown with shallow rusty orange-brown vertical fissures. Leaves alternate, to 35 cm long, paribipinnate with (3–) 6–10 pairs of pinnae 2– 10 cm long; crateriform gland (to 5 mm) on the petiole below or almost between the lower pair of pinnae; pinnules 11–22 pairs/pinna, 8–16 (–22) mm long, 2–5 mm wide, linear-oblong or weakly elliptic, acute at the tip, rounded to obtuse at the base and glabrous except on margins. Capitulum comprising 100–180 flowers, globose, axillary, (12–) 20–30 mm diameter, borne singly or in pairs, peduncle 2–4 cm long. Flowers white to pale cream; calyx c. 3 mm, glabrous at base, puberulent at apex, 5-toothed; petals narrowly oblanceolate, ca. 5 mm, pubescent; stamens 10, sparsely pubescent, ca. 7 mm; ovary shortly stipitate, sparsely pubescent; stigma cupular. Pod 3–20 (–45) per capitulum, linear-oblong, acute (beaked) or rounded



Immature pods each containing up to 20 seeds



Windbreak plants in Western Lowlands, Eritrea



Capitula borne singly or in pairs in leaf axils



Pods on pollard regrowth (cv. Tarramba)



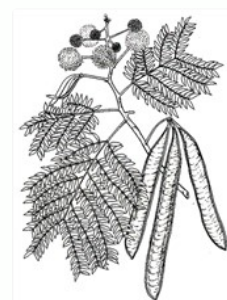
Maturing pods



Mature pods (cv. Cunningham)



Seeds



Leucaena leucocephala (Lam.) de Wit - flowering and fruiting branch.

Line illustration



Double row sowing in establishment year, Central Queensland, Australia



Aerial view of large scale plantings, central Queensland Australia

at apex, attenuate at base, 9–19 (–26) cm × 1.5–2 cm, pendant, glabrous or puberulous, brown at maturity, bearing (8–) 18–25 seeds/pod, dehiscent along both sutures. Seeds ovoid, flat, 6–10 mm long, 4–6.3 mm wide, brown. 15,000–20,000 seeds per kg.

ssp. *leucocephala*: relatively small, much-branched shrub/tree, buds, younger leaflets, stems and immature pods densely covered with fine greyish-coloured hairs (puberulous).

ssp. *glabrata*: relatively large and sparsely-branched tree younger stems glabrous. Immature pods glabrous and slightly lustrous.

ssp. *ixtahuacana*: small tree, immature pods glabrous and slightly lustrous.

Common names

Africa: lukina (Amharic); lusina, mlusina (Swahili); lucina (Tigrinya)

Asia: 白豆 荚 (China); klandingan, pethet (Javanese), peuteuy sélong (Sundanese), lamtoro, petai cina, petai selong (Indonesia); 白豆 荚 ginnemu (Japan); ipil ipil, bayani (giant ipil ipil), santa-elena, santaelena, elana, kariskis, palo-maria (Filipino/Tagalog), byatilis, luylyuy (Cebuano) (Philippines); 白豆 荚 chhàu-chheⁿ-á, chhàu-chhiⁿ-á; 白豆 荚 gín-háp-hoan, gún-háp-hoan (Taiwan)

English: leucaena (Australia); wild tamarind (Belize, Cayman Islands); lead tree (Florida); jumby bean (Bahamas); white popinac, white lead tree

French: graines de lin, faux mimosa, leucene, delin étranger, cassie blanc, leucaene à têtes blanches, monval, bois bourro

Indian subcontinent: vilayati baral, lasobayal (Gujarati); 白豆 荚 subabul, koobabul (Hindi); nagarjuna (Oriya), 白豆 荚 soundal, tagarai, nattucavundal (Tamil); kubabhal (Pakistan)

Indochina: bo: zagain; / bó zagáí, aseik-pye, aweya, bawzagaing (Burmese); 白豆 荚 kant^hum (Khmer); 白豆 荚 kathin, kh'oonz, koong khaaw (Lao); petai jawa, petai belalang (Malay); ผักกระถิน phak kratin, krà t^hin (Thai); kay keo dâu, keo dâu, keo giâu, schemu (Vietnamese)

Latin America: acácia-esponjeira, aroma branco (Brazil); guage, liliak, liliaque, tepeguaje dormilón (Mexico); zarcilla (Puerto Rico); guaslim (Campeche, Mexico); guaxin, huaxim (Mayan); huāxcuahuitl (Nahuatl); aroma blanca, aroma boba, aroma mansa, soplillo (Cuba); acacia bella rosa (Spanish); arabisca (Peru); acacia forrajera (Colombia)

Pacific Islands: tangantangan, tangan tangan, talantayan (Guam, Marshall Islands); talntangan, ganitnityuwan tangantan (Yap); tuhngantuhngan, rohbohtin (Kosrae); telentund (Palau); lopa samoa (American Samoa); fua pepe (American Samoa, Samoa); lusina (Samoa); pepe (Niue and Samoa); nito (Cook Islands);



Intersown with buffel grass, Central Queensland Australia



With *Cynodon nlemfuensis*, Colombia



Dry season with buffel grass, N Qld, Australia



Browsing



Cut and carry



Can be fed to pigs at relatively low levels of intake; pig eating leucaena, Nepal



Regrowth after frost, Thangool, Central Qld, Australia



Heavy psyllid infestation, Central Queensland Australia



Leucaena psyllid (*Heteropsylla cubana*)



Psyllid damage, Queensland Australia

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siale mohemohe (Tonga); balori, vaivai, vaivai du, vaivai ni Vavalagi (Fiji); cassis (Vanuatu); te kaitetua (Kiribati); false koa, koa haole (Hawaii); tavahi kaku (Niue); lamandro (PNG)

Distribution

ssp. *glabrata*

Native: now so widely distributed, almost impossible to determine endemicity.

Cultivated/naturalized: being used in an increasing number of countries in the Americas, Australasia, Asia and Africa.

ssp. *leucocephala*

Native:

Northern America: Mexico (Campeche, Chiapas, Oaxaca (s.e.), Quintana Roo, Tabasco, Veracruz, Yucatán)

Central America: Belize (n.)

Naturalized: throughout the tropics.

ssp. *ixtahuacana*

Native:

Northern America: Mexico (Chiapas)

Central America: Guatemala

Cultivated/naturalized: only recently identified.

Uses/applications

Forage

Highly valued as ruminant forage either as browse in pastures and/or protein banks or cut-and-carry.

Environment

Used as a hedgerow species and as a shade tree over coffee and cocoa. Has been used as a reclamation species following mining, but no longer used due to the weed risk. The most commonly researched species for alley farming systems.

Other

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. Ssp. *ixtahuacana* is particularly favoured in this role. The timber can be used for poles and minor construction, and as a fuelwood. It can be grown in dense rows as a living fence and used to support vine crops such as pepper and passionfruit.

Ecology

Soil requirements

In its native range, *L. leucocephala* grows on shallow limestone soils, coastal sands and seasonally dry, self-muching vertisol soils of pH 7.0–8.5. In cultivation, it requires well-drained soils with pH (H₂O) above 5.5, or above 5.0 where aluminium saturation is very low.

Tolerant of moderate salinity and alkalinity, but growth is poor on soils with low pH, low P, low Ca, high aluminium saturation, or high salinity.

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 mature plants will coppice from the base with resumption of growing temperatures.

Light

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



Seeds with bruchid beetle damage



Bruchid, *Acanthoscelides macrophthalmus*, used in biocontrol of *leucaena*.

Reproductive development

All subspecies flower and set seed throughout the year providing soil moisture and temperature are adequate. It often has a combination of flowers, immature and mature pods all present on the tree at the same time. Ssp. *leucocephala* is particularly precocious and free seeding.

Defoliation

Extremely tolerant of regular defoliation by cutting or browsing once established. *L. leucocephala* growing on less well-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 subsequent year may be poor.

Agronomy

Guidelines for establishment and management of sown forages.

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 (e.g. CB 3060, 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'.

Fertilizer

Normally not fertilized 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. Normally grown as a hedgerow with grasses or crops grown between hedgerows. Can be grown as a sole species as a protein bank.

Companion species

Grasses: In sub-humid environments, *Cenchrus ciliaris*, *Chloris gayana*, *Megathyrsus maximus*, *Panicum coloratum*. In the humid tropics, *Digitaria eriantha* (pangola), *Urochloa decumbens*, *U. humidicola*, *U. mosambicensis*.

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*. 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* (Lepidoptera: Cosmopterigidae), and by seed-eating bruchid beetles, three *Acanthoscelides* spp. and two *Stator* spp. (Coleoptera: Chrysomelidae: Bruchinae). Spur-throated locusts (*Austracris guttulosa*) occasionally attack *L. leucocephala*, temporarily defoliating mature plants and killing seedlings during early establishment.

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* Hemiptera: Coccidae) 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.

Ability to spread

Lower rate of spread under grazing, as cattle relish young seedlings. However, if left unmanaged during the growing season, stand density can increase greatly due to seed drop. Seed can be further disseminated by passage through the grazing animal or by water movement. Thickening up of hedgerows may occur where delayed grazing allows seed set and seedling recruitment.

Weed potential

Has very high weed potential due to hardseededness and high rates of seed production if not properly managed to reduce spread. This involves ensuring "leakage" from sown areas is controlled by strategic location of stands with respect to drainage lines, and careful defoliation management to minimize seed set in ungrazed situations. It readily colonises disturbed lands such as roadsides and stream banks, particularly where soils are limestone based. Weed potential is particularly severe for ssp. *leucocephala*, which 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% 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 with other forage tree legumes such as *Calliandra calothyrsus* and *Gliricidia sepium*.

Toxicity

Contains mimosine, a non-protein amino acid that has antimetabolic 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(1H)-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. *S. jonesii* was transferred to ruminant livestock in Australia in the mid 1980s and subsequently to Africa and China.

Feedipedia link

<https://www.feedipedia.org/node/282>

Production potential

Dry matter

Yields of forage vary with soil fertility, rainfall, altitude, density and cutting frequency from 1 to 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* hybridizes 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*. Hybridization with other diploid species of *Leucaena* is more difficult to achieve.

Seed production

In central Queensland, Australia (23° S) 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 dependant 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.
- Poses severe weed risk if not managed well.

Internet links

<https://www.agric.wa.gov.au/sites/gateway/files/Hughes%2C%20Colin%20-%20Leucaena-species%20diversity%20and%20genetic%20resources.pdf> (Leucaena: species diversity & genetic resources)

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- Note:** Detailed updates on knowledge relating to *Leucaena* were provided in papers presented at the International Leucaena Conference held at The University of Queensland, Brisbane, Australia, 1–3 November 2018. All papers were published under a publication agreement with the Organizing Committee in two Special Issues of Tropical Grasslands-Forrajes Tropicales: ILC2018 No. 1 - May 2019 Vol 7, No 2. 24 papers presented during Sessions 1–4 of the Conference. <http://www.tropicalgrasslands.info/index.php/tgft/issue/view/29/showToc> and ILC2018 No. 2 - September 2019 Vol 7, No 4. 36 papers presented during Sessions 5–8 of the Conference. <http://www.tropicalgrasslands.info/index.php/tgft/issue/view/31/showToc>.

Cultivars

'Tarramba' Granted PBR protection in Queensland, Australia (1997). Bred by the University of Hawaii from seed collected at 1,675 m altitude in Mexico as K636. Establishes more rapidly, and marginally more psyllid resistant and cool tolerant than 'Peru' and 'Cunningham'. More arboreal in habit cf. 'Cunningham'.

'Cunningham' Released in Australia (1976). 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 psyllid pressure is low and low temperatures do not restrict growth.

'Peru' Released in Australia (1962). 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 >10 °C.

'El Salvador' Released in Australia (1962). 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.

'K8' Released in Hawaii. Arboreal accession promoted by the University of Hawaii through the 1960s to 1980s. Widely planted throughout the tropics. Badly affected by the psyllid insect

'K28' Released in Hawaii. Promoted by the University of Hawaii as a multipurpose accession prior to K636. Reported to perform marginally better than K636 in acid soils.

'Romelia' Released by Cenicafé in Colombia (1992); = CIAT 21888; a mix of 4 CIAT accessions (CIAT 17481, CIAT 17482, 17491 and CIAT 17492) selected at Chinchiná, Caldas; 2,700 mm annual rainfall, 1,400 m asl., soil pH 5.1, Al saturation 22%.

'Subabul CO-1 (P)' Released in Tamil Nadu (1984). This is a selection of variety Giant Ipil K-28 of Subabul (*Leucaena leucocephala*) by TNAU, Coimbatore and state. The selection is high yielding (green leaf fodder 85 t/ha) with high protein and drought tolerance.

Promising accessions

K584 Selected in Hawaii, Florida, Australia and southeast Asia. Similar in growth and psyllid/cool tolerance to K636 but slightly more branching in habit. High yielding in agronomic trials.

OFI 117/92 Selected in Australia. *L. leucocephala* subsp. *ixtahuacana*, similar productivity to K636 and K584 but with slightly higher psyllid resistance. Collected at 1,230 m asl in Ixtahuacán, Guatemala.

OFI 32/88 Selected in Southeast Asia. High yielding in humid tropical low psyllid environments. Collected as an exotic accession from Haiti.

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