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

Synonyms
Leucaena leucocephala ≡ basionym: Acacia leucocephala (Lam.) Link (Leucaena glauca Benth., which is considered a synonym in The Plant List, was regularly used to refer to this species in earlier literature.)

subsp. glabrata ≡ basionym: Leucaena glabrata Rose

subsp. leucocephala ≡ basionym: Mimosa leucocephala Lam.

Family/tribe
Family: Fabaceae (alt. Leguminosae)
subfamily: Caesalpinioideae (mimosoid clade*) tribe: Mimoseae.


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

Chinese: 雪花 yin he huan

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, morval, bois bourro

India: vilayati baral/asobayal (Gujarati); subabul, koobabul (Hindi); nagarjuna (Oriya); soundal, tagarai, nattucavundal (Tamil)

Indochina: bo: zagain: / bɔ́ zagáĩ, aseik-pye, aweya, bawzagaing (Burmese); kant’un (Khmer); kathin, kh’oonz, koong khaaw (Lao); petai jawa, petai belalang (Malay); phak kratin, krà t‘lin (Thai); kay keo dâu, keo dâu, keo giậu, schemu (Vietnamese)

Indonesia: lamtoro, petai cina, or petai selong; klandingan, pethet (Javanes); penseuy selong (Sundanese)

Japanese: गिन्नेमु ginnemū
Psyllid damage on K636 Queensland Australia

Close-up psyllid affecting leucaena

Leucaena and Cynodon nlemfuensis Colombia

Regrowth after frost Central Queensland Australia

With buffel grass north Queensland Australia

With buffel grass central Queensland Australia

Grazing leucaena

Aerial view of large scale leucaena plantings Central Queensland Australia

Latin America: guage, liliak, liliaque, tepeguaje dormilón (Mexico); zarcilla (Puerto Rico); guasim (Campeche-Mexico); guaxin, huaxim (Mayan); huaxcuahuitl (Nahuatl); aroma blanca, aroma bobo, aroma mansa, sopilillo (Cuba); acacia bella rosa (Spanish); arabisca (Peru); acacia forrajera (Colombia)

Pacific Islands: tangantangan, tangan tangan, talantayan (Guam, Marshall Islands); talantayan, ganithiywan tangantan (Yap); tuhungntuungan, rohbohtin (Kosrae); telentund (Palau); lopa samoa (American Samoa); fua pepe (American Samoa, Samoa); lusina (Samoa); pepe (Niue and Samoa); nito (Cook Islands); siale mohemohe (Tonga); balori, vaivai, vaivai du, vaivai ni Vavalagi (Fiji); cassis (Vanuatu); te kaitetuia (Kiribati); false koa, koa haole (Hawaii); tavahi kaku (Niue); lamandro (PNG)

Pakistan: kubabhal

Philippines: ipil ipil, bayani (giant ipil ipil), santa-elena, santielaen, elana, kariskis, palo-maria (Filipino/Tagalog); byatilis, luyluy (Cebuano)

Taiwanese: chhàu-chheⁿ-á, chhàu-chhiⁿ-á; gîn-ha̍p-hoan, gûn-ha̍p-hoan

**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, paripinnate 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 ca. 3 mm, glabrous at base, puberulent at apex, 5-toothed; petals narrowly oblanceolate, ca. 3 mm, glabrous; 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 at apex, attenuate at base, 9 -19 (-26) cm x 1.5-2 cm, pendant, glabrous or puberulous, brown at maturity, bearing (8 -) 18-25 seeds/pod, dehiscing along both sutures. Seeds ovoid, flat, 6-10 mm long, 4-6.3 mm wide, brown. 15,000–20,000 seeds/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.

**Distribution**
ssp. glabratata

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, Yucatan)

Central America: Belize (N)

Naturalized: Throughout the tropics

ssp. ixtahuacana

Native:

Northern America: Mexico (Chiapas)

Central America: Guatemala

Cultivated/naturalized: only recently identified

Ecology

Soil requirements
In its native range, *L. leucocephala* grows on shallow limestone soils, coastal sands and seasonally dry, self-mulching 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 25-30ºC for optimum growth. Growth ceases at 15-16ºC. 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 temptratures.

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

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.

Uses/applications

Forage
Highly valued as ruminant forage either as browse 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.

**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 bentazon 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, Megathysrus maximus, Chloris gayana, Panicum coloratum. In the humid tropics, Digitaria eriantha cv. Pangola, Urochloa humidicola, Urochloa decumbens, 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. Tararamba 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 Hamperia: 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 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(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 bacterium, *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](https://www.feedipedia.org/node/282)

**Production potential**

**Dry matter**

Yields of forage vary with soil fertility, rainfall, altitude, density and cutting frequency from 1-15 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. confertilflora*, 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 bentazon (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

Selected references


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 in 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%.

'Subabul CO-1 (P)' Released in Tamil Nadu (1984) This is a selection of variety Giant Ipiil 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 altitude in Ixtahuacan, 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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