Leucaena diversifolia

Scientific name

Leucaena diversifolia (Schltdl.) Benth.

Synonyms

Basionym: *Acacia diversifolia* Schltdl.

Note: There has been some confusion over the years at the distinction between *L. diversifolia* and *L. trichandra*, some forms of the latter sometimes being referred to as *Leucaena diversifolia* (Schldl.) Benth. subsp. *stenocarpa* (Urban) Zárate.

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

Tree (3–) 5–15 (–20) m tall, stem (10–) 20–35 (–40) cm in diameter. Form varies from shrubby and highly branched to more arborescent with a short clear bole to 5 m giving rise to upright angular branching and a rounded, open spreading crown. Bark mid grey-brown with shallow, rusty orange-brown, vertical fissures; slash reddish. Leaves paribipinnate with (14–) 16–24(–28) pairs of pinnae along rachis (3.5–) 5–7 (–8) cm long, densely covered with white hairs; petiolar gland concave, cup-shaped, elliptic, inserted between lowest pair of pinnae; pinnules linear-oblong, (2.9–) 4 –5.5 (–7) mm long, 0.8–1 mm wide, 48–58 pairs per pinna; acute at tip, strongly asymmetric, round to obtuse at base and glabrous except on margins. Capitulum (flower head) globose, 11–15 mm diameter, pale pink to bright pink, occasionally bright scarlet, in groups of 1–5, developing in the leaf axils of actively growing, indeterminate shoots. Pods 1–6 per capitulum, narrowly linear-oblong and flat, 10–13 cm long, 13–16 mm wide, papery in texture, dark brown or reddish-brown, sometimes lustrous, may be hairless or covered in dense velvety hairs, containing 6–20 seeds; opening along both sutures. Seeds 4.3–5.5 mm wide, 2.7–3.4 mm long. Seeds 60,000–80,000 seeds per kg (smallest of any species of *Leucaena* spp.).

Similar species

***L. diversifolia*:** 16–24 pairs of pinnae/leaf; 48–58 pairs of pinnules/pinna; length of pinnules 4–5.5 mm; width of pinnules 0.8–1 mm.


Leaves paribipinnate


Tree to 20m tall, Papua New Guinea highlands


Coppiced plants, CIAT-Quilichao, Colombia


L. diversifolia (L) vs *L. trichandra* (R)


Capitula (flower heads) borne in groups of 1-5 in the leaf axils of actively growing shoots.


Inflorescence a capitulum


Immature pods; 6-20 seeds/pod


Prolific seed production (CPI 46568)


Seeds


Pollard regrowth after cutting at 50cm.

***L. trichandra*:** 11–22 pairs of pinnae/leaf; 30–40 pairs of pinnules/pinna; length of pinnules 4–7mm; width of pinnules 1–2 mm.

After grazing, South Johnstone, N Qld, Australia

Moisture stressed plant, Southedge, N Qld, Australia (CPI 46568)

Common names

Asia: pudia soundal (India); lamtoro (Indonesia); ipil-ipil (Philippines)

English: diversifolia, highland leucaena, leucaena, red leucaena, wild tamarind; wild tamarind (Jamaica); upland koa haole (Hawaii)

French: leucaena petit feuille

Latin America: guaje, guajillo (Mexico)

Distribution

Native:

Northern America: Mexico (Chiapas, Hidalgo (e.); Oaxaca, Puebla, Tabasco, Veracruz)

Central America: Guatemala (Huehuetenango)

Uses/applications

Forage

Has been extensively evaluated in agronomic and to a lesser extent animal production trials.

Environment

L. diversifolia can be used for soil improvement (green manure), soil conservation and erosion control in diverse agroforestry combinations and systems including alley farming, live-barriers on terrace boundaries, shelterbelts or windbreaks, or simply as dispersed trees over crops. It is used as a shade over coffee in frost-free highland tropical locations.

Other

Used in hybridization programs to improve psyllid resistance and acid-soil tolerance of *L. leucocephala*. The wood is used for fuel and charcoal production and for small dimension poles. Its timber value for poles is limited by lack of durability and susceptibility to attack by termites and wood borers. It is inferior as a fuelwood and charcoal base to *Acacia* or *Prosopis*. The pulp is suitable for paper production. Villagers in Mexico and Guatemala occasionally consume the pods.

Ecology

Soil requirements

In its native range, *L. diversifolia* grows in deep, free-draining soils of mildly acid reaction (pH 5.5–6.5). While it grows best in fertile soil, it is tolerant of leached, lower fertility soils.

Moisture

Annual rainfall in the region where this species originates ranges from (600–) 1,500–2,800 (–3,500) mm, with very short dry seasons (0–3 months). It is not very drought tolerant, nor tolerant of waterlogging.

Temperature

Grows at 30–1,500 (–1,700) m asl in frost-free climates between about 16 and 20 ºN where average annual temperatures range from 18 to 25 ºC. Seedlings and young established plants can be killed by moderate frosts.

Light

Coming from regions with constant cloud and mist cover, it possesses some shade tolerance.

Reproductive development

Flowers predominantly over early summer (May to June in Mexico), fruiting over autumn and winter (August to February in Mexico). However, with the exception of mid-winter, it can flower and set fruit year-round.

Defoliation

Most accessions were tolerant of regular cutting in forage production trials in Hawaii, Florida, Australia and southeast Asia. CPI 33820 was tolerant of regular grazing by cattle in northern Queensland, Australia.

Fire

Mature plants are tolerant of moderate intensity fires, regrowing readily from burnt stumps or branches.

Agronomy

Guidelines for establishment and management of sown forages.

Establishment

For best results plant on deep, well-drained soils with a pH above 5.0, maintaining a weed-free area of at least 2 m around establishing plants. Seed must be scarified to break the testa. Mechanical scarification, using coarse sandpaper (for small seed lots) or abrasive lined rotating drum scarifiers, is preferred. Hot water treatment of seed is no longer recommended. Specific rhizobium is required (eg. CB 3060, TAL 1145, LDK4). Complete cultivation is recommended in extensive plantings. Seeding rates of 1.5–3.0 kg/ha are planted into rows 4–9 m apart. 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 before or after emergence of leucaena seedlings. Small areas can be planted using seedlings that 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. *L. diversifolia* has proved as slow as, or slower than *L. leucocephala* cv. Cunningham to establish in trials throughout Australia and southeast Asia.

Fertilizer

Normally not fertilized. Starter N and P may be used when establishing into depleted soils, and lime may be required on soils with pH <5.0. Replacement fertilizer is required in highly productive cut-and-carry systems.

Compatibility (with other species)

The low palatability of *L. diversifolia* under grazing may result in dense canopies and consequently, low productivity of understorey grasses.

Companion species

Grasses: Has been grown in combination with *Urochloa decumbens* in humid-tropical northern Australia.

Pests and diseases

Susceptibility to psyllid attack varies among accessions of different ploidy levels, the diploid forms exhibiting greater resistance than the tetraploids. Soft/long brown scale (*Coccus longulus* Hemiptera: Coccidae) attacks the immature stems 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. A range of 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 activity of two moths, *Ithome lassula* (Lepidoptera: Cosmopterigidae) and *Spatularia mimosae* (Lepidoptera: Tineidae), and to some extent by seed-eating bruchid beetles, *Acanthoscelides* spp. (Coleoptera: Chrysomelidae: Bruchinae). Both diploid and tetraploid forms are highly resistant to other seed beetles, *Araecerus levipennis* and *A. fasciculatus* (Coleoptera: Anthribidae).

A range of pathogenic fungi occasionally attack *L. diversifolia*. Newly emerged nursery and field-grown seedlings are susceptible to damping-off diseases caused by the fungal species, *Pythium* or *Rhizoctonia*. Leaf spot disease caused by the fungus, *Camptomeris leucaenae,* can lead to serious defoliation and dieback. *Fusarium semitectum* causes gummosis and canker on stems, branches and penduncles, and dark brown spots on young twigs, leaves, penduncles, pods and seeds, eventually causing the tree to die.

Ability to spread

Has potential to colonise bare ground from seed but is unlikely to spread under grazing.

Weed potential

Likely to be similar to *L. leucocephala*, being self-compatible and flowering and fruiting over an extended season. Has significant potential to become a weed of disturbed areas, but no records of current weediness were cited.

Feeding value

Nutritive value

Leaves of *L. diversifolia* generally have lower nutritive value (lower palatability, digestibility, intake and crude protein content, and higher condensed tannin content) than those of *L. leucocephala.* Crude protein concentrations range from 25 to 32% of DM. *In vitro* DM digestibility ranges from 56 to 61% of DM, but *in vivo* DM digestibility is low due to high concentrations of condensed tannins (6–19% of DM). The very high CT concentrations preclude the feeding of *L. diversifolia* to monogastrics and limit its value as a protein supplement for ruminants.

Palatability/acceptability

CPI 33820 was reported to be of similar low palatability to that of *L. pallida* and *L. trichandra* in long-term grazing trials. A range of different accessions was well accepted by sheep and cattle in short-term grazing and cafeteria trials. In Hawaii, it was well browsed by Axis deer to the point of plant destruction.

Toxicity

Contains low concentrations (approx. 2% of DM) of the toxic amino acid, mimosine. Also contains condensed tannins (6–19% of DM).

Production potential

Dry matter

Annual leaf dry matter production can reach 10–16 t/ha, but this is not common.

Animal production

There are few reports of animal production from *L. diversifolia*. In humid-tropical northern Australia, *L. diversifolia* CPI 33820 supported liveweight gains in steers of 0.53 kg/head/day over a 6-month period, which exceeded that from the sabi grass (*Urochloa mosambicensis* cv. Nixon) control treatment (0.38 kg/head/day).

Genetics/breeding

Chromosome number is variously reported as $2n = 2x = 52$, 54, 56 and $2n = 4x = 104$. The tetraploid form, which is thought to be an allotetraploid with *L. pulverulenta* as the maternal parent, is self compatible, but also hybridizes well with other tetraploid species of *Leucaena*, although less well with the diploid species. However, some differentiate between *L. trichandra* and *L. diversifolia* on the basis of ploidy level, the former being diploid and the latter tetraploid.

Seed production

Produces large amounts of seed over an extended season under suitable rainfall conditions. Seed orchards were successfully developed in Hawaii and northern Australia, but no estimates of seed yields are given.

Herbicide effects

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 following slashing will kill trees although repeat applications may be necessary.

Strengths

- Possesses some low temperature adaptation.
- Some accessions are psyllid resistant .
- Modest tolerance of acid soils
- Tolerant of regular coppicing.
- Has potential as a medium density pole timber or fuelwood.

Limitations

- Low palatability to grazing ruminants.
- Relatively low nutritive quality, supporting only moderate liveweight gains.
- Poorly adapted to dry and/or hot environments.

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)

Selected references

Dalzell, S.A. (2019) Leucaena cultivars – current releases and future opportunities.Tropical Grasslands-Forrajes Tropicales 7:56–64. doi.org/10.17138/tgft(7)56-64

Hughes, C.E. (1998) *Leucaena*, A genetic resources handbook. Oxford University Press, Oxford, UK. bit.ly/2Iw31af

Jones, R.J., Galgal, K.K., Castillo, A.C., Palmer, B., Deocareza, A. and Bolam, M. (1998) Animal production from five species of *Leucaena*. In: Shelton, H.M., Gutteridge, R.C., Mullen, B.F. and Bray, R.A. 1998 (eds) *Leucaena* - adaptation, quality and farming systems. Proceedings of a Workshop Held in Hanoi, Vietnam, 9–14 February 1998. ACIAR Proceedings No. 86. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia. p. 247–252. purl.umn.edu/135197

Mullen, B.F., Shelton, H.M., Gutteridge, R.C. and Basford, K.E. (2003) Agronomic evaluation of *Leucaena*. Part 1. Adaptation to environmental challenges in multi-environment trials. Agroforestry Systems 58:77–92. doi.org/10.1023/A:1026068215337

Shelton, H.M., Gutteridge, R.C., Mullen, B.F. and Bray, R.A. (eds). (1998) *Leucaena* - adaptation, quality and farming systems. Proceedings of a Workshop Held in Hanoi, Vietnam, 9–14 February 1998. ACIAR Proceedings No. 86. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia. purl.umn.edu/135197

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

'FD 1423' Released in Tamil Nadu (1999). Introduced by TNAU, Coimbatore. Selected for high psyllid tolerance. Suitable for rainfed conditions; green leaf yield is 55 t/ha.

Promising accessions

CPI 33820 Selected in Australia for its psyllid resistance and yield potential; was put on pre-release pending the outcomes of animal production trials. Its poor ability to support high liveweight gains precluded further accession development.

K778, K784, K802 Selected in Hawaii and Australia. Collected at an altitude of 1,200 m asl in Veracruz, Mexico and these appeared to be well adapted to lower temperatures in Hawaii and at Brisbane, Australia. They also possessed considerable psyllid resistance and were very productive in fuelwood production trials.

K785 Selected in Hawaii. Similar to the above accessions, it has been used in the development of a recent KX3 hybrid accession adapted to upland tropical environments.