Gliricidia sepium

Scientific name

Gliricidia sepium (Jacq.) Kunth

Synonyms

Basionym: *Robinia sepium* Jacq.

Family/tribe

Family: *Fabaceae* (alt. *Leguminosae*) subfamily: *Faboideae* tribe: *Robinieae*.

Morphological description

Small to medium-sized tree up to 10–12 m high. Branching frequently from the base with basal diameters reaching 50–70 cm. Bark is smooth, varying in colour from whitish grey to deep red-brown. Trees display spreading crowns. Leaves are odd pinnate, usually alternate, sub-opposite or opposite, to approximately 30 cm long; leaflets 5–20, ovate or elliptic, 2–7 cm long, 1–3 cm wide. Leaflet midrib and rachis are occasionally striped red. Inflorescences appear as clustered racemes on distal parts on new and old wood, 5–15 cm long, flowers borne singly with 20–40 per raceme. Flowers bright pink to lilac, tinged with white, usually with a diffuse pale yellow spot at the base of the standard petal, calyx glabrous, green, often tinged red. Standard petal round and nearly erect, approximately 20 mm long; keel petals 15–20 mm long, 4–7 mm wide. Pod green, sometimes tinged reddish-purple when unripe, light yellow-brown when mature, narrow, 10–18 cm long, 2 cm wide, valves twisting in dehiscence; seeds 4–10, yellow-brown to brown, nearly round. 7,000–10,000 seeds per kg.

Common names

Africa: abgook maniye (Nigeria)

Asia: □□□ ge li dou (China); madri (Telugu), ■■■■■■ saranga (Bengali), ■■■■■■■■■■ gobbarda mara, gobbaradgidda (Kannada), ■■■■■■■■■■ giripushpa (Marathi), ■■■■■■■■■ siima konna (Malayalam), ■■■■■■■■■■ seemai agathi, vivasaaya thegarai (Tamil), (India); gamal, klérésédhé, liriksidia (Java/Indonesia); khê fàlangx, khê nooyz (Laos); bunga jepun (Malaysia); balok-balok, cacaute, kakauati, kakawate, madre de cacao, madriado, madrecacao (Philippines); แค ฝรั่ง /khae farang (Thailand); anh dào gía, sát thu, hông mai (Vietnam)

English: gliricidia; Mexican lilac, mother of cocoa (India); Nicaraguan cocoashade (Trinidad and Tobago); quick-stick (Guyana, Jamaica); Aaron's rod (Jamaica); St. Vincent plum, tree of iron

Latin America: mãe-de-cacau, planta-mãe-do-cacau (Brazil); bala (Costa Rica, Panama), cacahuananche


Small to medium-sized tree branching frequently from the base, Indonesia


Leaves odd pinnate with 5–20 ovate or elliptic leaflets


Inflorescences


Inflorescences: clustered racemes on distal parts of stems


Flowers borne singly with 20–40 per raceme


Pods green, sometimes tinged reddish-purple when unripe, light yellow-brown when mature


Seeds


Line illustration


Pollard regrowth


Living fence Bali, Indonesia

(Guatemala), cacahuanāntli (Nahuatl, Mexico), cocuite (Veracruz, Mexico), mata ratón, matarratón (Colombia, Guatemala, Cuba), madero negro, maderu negru (Nicaragua, Costa Rica), palu de bala (Panama), palu de sol (Tamaulipas, Mexico), piñón de Cuba (Dominican Republic), madre de cacao, madriado, madricacao, madriago, piñón cubano (Spanish)

Pacific: rechesengel (Palau)


In hedgerows with *Urochloa decumbens* cv Basilisk


Feeding to Bali cattle


Feeding to goats

Distribution

Native:

Northern America: Mexico (central & south)

Central America: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua

Cultivated/naturalized:

Widely dispersed and use throughout tropical Latin America, South Asia, South-east Asia, Pacific and Africa

Uses/applications

Forage

Multipurpose nitrogen fixing tree, used as cut-and-carry feed for ruminants, protein banks and livestock shade. Leaf meal can be fed to rabbits and to poultry for protein and to improve pigmentation of eggs.

Environment

It has been planted to stabilize soil, to prevent erosion and to reclaim denuded land or land infested with *Imperata cylindrica*. As many of the common names suggest, it has been used as a shade tree in plantation crops, especially cacao, but also tea and coffee. It can form hedges and provide green manure in intercropping systems such as alley-cropping systems.

Other

It is often used as a trellis for climbing crops (*e.g.* pepper and vanilla). The hard wood can be used as a fuel, for charcoal production, as posts and farm implements, for construction and railway sleepers, and locally for furniture. The trees have ornamental value and the flowers are a source of nectar for bees. The juice of the leaves, bark and roots is traditionally used to treat eczema and to alleviate itches and wounds. Several plant parts are used to produce rodent poison.

Ecology

G. sepium occurs naturally in seasonally dry forest areas.

Soil requirements

Adapted to a wide range of well-drained soils. In its native range, often found on highly eroded soils of volcanic origin with pH 4.5–6.2, but is also found on sands, heavy clays and slightly alkaline, calcareous limestone soils. Poor survival on soils with high Al saturation. In Australia, the tree is thought to be suitable for low-calcium soils. Does not grow well on wet or waterlogged soils.

Moisture

Drought tolerant and adapted to an annual rainfall regime of 650–3,500 mm. Largely deciduous where dry seasons are moderate to severe, but evergreen where there is sufficient moisture throughout the year.

Temperature

Mean annual temperatures across the native range vary considerably, from 21 to 29 ºC. Leaves abscise when night temperatures fall below 15 ºC. Grows to an elevation of 1,200 m asl in its native range, possibly to as high as 1,600 m asl.

Light

Little shade tolerance.

Reproductive development

Strongly self-incompatible despite having hermaphrodite flowers pollinated by insects. Flowering begins at the start of the dry season at about 6–8 months of age. Trees at lower coastal sites flower well before those at higher altitudes. A tree can produce vast numbers of flowers (up to 30,000) that attract a wide variety of insects. Pod ripening takes 45–60 days. In very wet areas, plants may flower but produce little if any fruit.

Defoliation

Gliricidia tolerates repeated cutting very well. For forage, first cut 8–12 months after sowing at 0.5–1.0 m above soil level, and thereafter every 2–4 months depending on rainfall and temperature. The tree is largely deciduous in the dry season. To prevent leaf loss at this time, cut at the end of the rains and again at 8 weeks into the dry season. A final cut at 16 weeks into the dry season may be possible. Gliricidia is normally used as a cut-and-carry forage and is rarely directly grazed. Goats accustomed to gliricidia will eat the bark as well as leaves and small stems and may kill young trees.

Fire

Tolerates fire well, and the trees re-sprout when the rains arrive. May dominate secondary vegetation where regular, low-intensity fires occur.

Agronomy

Guidelines for establishment and management of sown forages.

Establishment

Sowing depth for seeding into the field or nursery beds is 2 cm. Scarification is unnecessary, and germination rates of >90% are typical. Seedlings establish rapidly, generally reaching a height of 3 m before flowering at 6–8 months of age.
However, trees are normally established from cuttings, using stakes of 5–6 months of age, 1.5 m long and with a diameter of 3.5–4.0 cm. If the moisture is adequate, foliage will appear in 4 weeks. For living fences, use stakes 1.5–2.5 m long with diameters of 5–10 cm, planted 1.5–5.0 m apart to 20 cm depth. For densely planted protein banks, use stakes 50 cm long and six months of age. Various planting patterns can be used e.g. double rows or triangular. Plant populations range from 4,000 to 10,000 trees/ha. Very high densities are used in small protein banks. The direction of planting should be east to west to maximise sunlight interception.

Fertilizer

As green manure, 15 t/ha/year of leaf biomass can provide the equivalent of 40 kg N/ha/year to companion crops and forages. Tolerant of some low soil fertility (but not productive; will respond to lime on low pH soils.

Compatibility (with other species)

Grasses: shade tolerant grasses such as *Stenotaphrum secundatum* and *Paspalum notatum*.

Companion species

Generally planted as a living fence, as a protein bank, in hedgerows with crops or pastures in the inter-row, or as scattered individual trees in smallholder forage and open-plantation systems.

Pests and diseases

Despite being widely grown throughout the tropics, *G. sepium* has remained relatively free of serious diseases. The lack of diseases is thought to be due to the tendency of the species to be leafless for periods of the year, thus reducing the likelihood of epidemics. Several incidences of insect problems have been noted in exotic environments. For example, aphids, mealy bugs and scale insects occasionally attack trees in Indonesia and the Caribbean.

Ability to spread

Will not spread under grazing as recruiting seedlings, if there are any, will not compete strongly with established grasses and are easily killed by grazing livestock.

Weed potential

Aggressive pioneer species following slash and burn agriculture in its native range. Limited seed production in exotic locations due to lack of pollinators and unsuitable environments for seed set limits weed risk. Severe weed in Jamaica, but not reported as a weed elsewhere.

Feeding value

Nutritive value

High nutritive value. Crude protein content 18–30% and in vitro digestibility 60–65%. With the exception of palatability, variability in nutritive quality among provenances has not been assessed.

Palatability/acceptability

Palatability problems occur with ruminants depending on prior experience. Naïve animals seem to refuse leaves on the basis of smell, often rejecting them without tasting, suggesting that the problem lies with volatile compounds released from the leaf surface. However, no palatability problems are reported in Indonesia, Sri Lanka, Colombia or Guatemala where successive generations of ruminants have been fed gliricidia. Wilting leaves for 12–24 hours before feeding increases intake. Prior experience is the most important attribute of palatability, so that local landraces are most preferred. While naïve animals are used, provenances from Mexico tend to be less palatable compared to those from Costa Rica and Colombia.

Toxicity

Toxicity is well known in Central America, where the leaves or the ground bark, mixed with cooked maize, are used as a rodenticide. This toxicity is thought to be due to the conversion by bacteria of coumarin to dicoumerol during fermentation. May be toxic or inhibit growth of monogastric animals such as rabbits and poultry if fed as a sufficiently high component of the diet. Little evidence of toxic effects with ruminants fed either fresh or wilted leaves. HCN concentrations of up to 4 mg/kg and cyanogens may be present. Gliricidia is suspected to be a nitrate accumulator. Unidentified alkaloids and tannins have also been reported.
Evidence of toxicity under practical feeding conditions is limited. The balance of evidence suggests that the plant may be toxic to non-ruminants but conclusive evidence of toxicity to ruminants under normal feeding is lacking.

Feedipedia link

https://www.feedipedia.org/node/552

Production potential

Dry matter

Annual leaf DM production varies from 2 to 20 t/ha/year, depending on a wide range of factors. In fodder plots, annual yields of 5–16 t/ha of leaf DM, or up to 43 t/ha fresh leaves have been obtained. In Nigeria, gliricidia hedgerows interplanted with 4 rows of *Megathrysus maximus* yielded 20 t/ha/year of total DM (grass and gliricidia).

Severe leaf fall occurs following flowering in seasonally dry environments. Harvesting of leaf in the early dry season will delay flowering, prevent or limit losses from leaf fall, and maximise regrowth. In West Timor, Indonesia, highest levels of dry season (March–November) forage yields were obtained from harvesting in April and again in June and August.

Animal production

Gliricidia is normally used as a green forage, protein supplement to low-quality tropical forages and by-products for cattle, sheep and goats. It may be used as the sole feed in the dry season. Feeding levels have been 1–3% of body weight for cattle and goats, indicating a supplementation level of 30–100%, although a 20–40% level is more common. Increases in liveweight gains of approximately 25% have been reported for steers grazing gliricidia-grass pastures, compared with steers grazing grass alone. Results from experiments with dairy cows and buffaloes reported similar or slightly increased milk yield and milk fat yield when concentrates were replaced by gliricidia forage up to about 25% of intake.

The effects of gliricidia forage on reproducing ruminants have been variable. In one trial, ewes supplemented with gliricidia produced a higher lamb crop, better lamb weights and had reduced ewe weight loss compared with those not fed gliricidia. In an unrelated trial, lambing results were poorer when gliricidia was fed, due to lower feed intake, possibly as a result of insufficient adaptation to the forage.

Laying chickens fed sun-cured gliricidia at 4.5% of total diet gave good egg production, egg weight and yolk colour. Yellow yolk colour can be achieved by feeding milled leaves at 2–4% of the ration. Diets containing up to 10% gliricidia can be fed to growing chicks without affecting performance and survival, but higher rates may have anti-nutritive effects.

Genetics/breeding

2*n* = 22, 28. Gliricidia is an insect-pollinated obligate outbreeder. There are no breeding programs involving gliricidia although there have been studies on the genetic diversity of populations using molecular techniques. The Oxford Forestry Institute evaluated 28 provenances of gliricidia in multi-location trials. See notes below on promising accessions. There appears to be only small gains achievable from recurrent selection for leaf biomass (8% from a single cycle of selection).

Seed production

Has the potential to produce abundant seed. Seeds are shed from pods through explosive dehiscence with seed dispersal distances of up to 40 m. Seed production varies with provenance, ranging from 75 kg/ha for 'Belen Rivas' up to 180 kg/ha for 'Monterrico', based on 7 seeds/pod and a seed weight of 8,000 seeds/kg.

Herbicide effects

Unknown. Likely to be similar to *Leucaena leucocephala*.

Strengths

- Multipurpose tree.
- Fairly wide climatic adaptation.
- Ease of establishment from stem cuttings.
- High potential DM production.
- High CP content and nutritive value for ruminants.

Limitations

- Familiarization is required before ruminants will eat readily.

- Possible toxicity problems if fed to monogastric animals.
- Lack of adaptation to soils that are not fertile and well-drained.
- Lack of cool season adaptation and frost tolerance.
- Regional weed potential.

Internet links

https://www.cabi.org/isc/datasheet/25380

https://indiabiodiversity.org/species/show/31390

http://www.worldagroforestry.org/treedb/AFTPDFS/Gliricidia_sepium.PDF

https://uses.plantnet-project.org/en/Gliricidia_sepium_(PROSEA)

Selected references

Atta-Krah, A.N. and Sumberg, J.E. (1988) Studies with *Gliricidia sepium* for crop/livestock production systems in West Africa. Agroforestry Systems 6:97–118. doi.org/10.1007/BF02344748

Stewart, J.L., Allison, G.E. and Simons, A.J. (1996) *Gliricidia sepium*: Genetic resources for farmers. OFI Tropical forestry papers No. 33. University of Oxford, Oxford, UK. bit.ly/2UtfiAZ

Wiersum, K.F. and Nitis, I.M. *Gliricidia sepium* (Jacq.) Kunth ex Walp. In: Mannetje, L't. and Jones, R.M. (eds) Plant Resources of South-East Asia No. 4. Forages. Pudoc Scientific Publishers, Wageningen, the Netherlands. p. 133–137. edepot.wur.nl/327785

Cultivars

None released although elite provenances have been identified.

Promising accessions

Despite its widespread use and studies on genetic and agronomic diversity within and between naturally occurring populations, there has been limited studies on agronomic and genetic diversity across the range of material now in widespread use across the tropics.

'Retalhuleu' Selected by the Oxford Forestry Institute, UK. An accessions collected from Retalhuleu, Guatemala. Outstanding provenance for both leaf and wood production in multi-location trials.

'Belan Rivas' Selected by the Oxford Forestry Institute, UK. An accession collected from Belan Rivas, Nicaragua. After 'Retalhuleu', next best provenance for both leaf and wood production in multi-location trials.

'Monterrico' Selected by the Oxford Forestry Institute, UK. An accession collected from Monterrico, Guatemala. Produced very high leaf yields but relatively low stem yields in multi-location trials.