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Gliricidia sepium (Jacq.)

Leguminosae

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Synonyms

A closely related white flowered taxon, *Gliricidia maculata* H.B.K., is less common although it is frequently confused with *G. sepium* despite its discontinuous distribution in the Yucatan Peninsula. Other names used in the literature include: *Gliricidia sepium* (Jacq.) Walp. and *Gliricidia sepium forma maculata* Urb.

Common names

Gliricidia, mata raton (Spanish)

Status

Gliricidia is an increasingly used forage crop in cut-and-carry systems in parts of the humid tropics including southeast Asia and Sri Lanka. In other areas such as West Africa, India and the Philippines, its use is severely limited by palatability problems; it is little used as forage within its native range in Central America. Despite mixed perceptions of gliricidia as a forage crop, it has been widely promoted by development agencies and researched, due largely to its high productivity and quality. Interest has increased in recent years following the widespread defoliation of *Leucaena* by psyllid. Gliricidia is one of the few forage trees capable of leaf yields comparable to those of leucaena and will grow on a wider range of soils, tolerating low pH provided that this is not associated with high aluminium saturation. After *Leucaena leucocephala*, gliricidia is believed to be the most widely cultivated multipurpose tree. It has not been used in commercial livestock production systems. A workshop was held in Costa Rica in 1987 to identify research priorities and prepare a practical manual on Gliricidia Production and Use (NFTA, 1987). Holm *et al.* (1979) report gliricidia as a severe weed in Jamaica.

Non-forage uses:

Gliricidia occurs in abundance throughout its native range in Mesoamerica. Its domestication has been in progress for millennia. The Spanish called it 'madre de cacao' to describe its use as a cocoa shade. The toxic properties of its seeds and bark give rise to the generic epithet (*Gliricidia* = mouse killer) as well as some common names (e.g. mata-raton). Present day uses throughout the native range (firewood, hedges, shade, poles and as an ornamental) are likely extensions of early utilization. *Gliricidia sepium* has also been used extensively throughout the humid tropics. These landrace populations are remnants of introductions used to shade plantation crops although recently they are being integrated into farming practices for poles, firewood, hedges, forage, green manure and soil

stabilisation.

Description

Gliricidia sepium is a small to medium-sized, thornless tree which usually attains a height of 10-12 m. Branching is frequently from the base with basal diameters reaching 50-70 cm. The bark is smooth and can vary in colour from whitish grey to deep red-brown. The stem and branches are commonly flecked with small white lenticels. Trees display spreading crowns. Leaves are imparipinnate, usually alternate, subopposite 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. Fruit 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.

Environmental adaptation

Despite the widespread present occurrence of *gliricidia* in cultivation throughout Central America and Mexico, it is likely to be native only in seasonally dry areas. It is largely deciduous during the dry season. In areas where sufficient moisture prevails, however, the tree is evergreen (e.g. Kalimantan, Indonesia; Seibert 1987).

Its temperature requirements are not too exacting as shown by the wide variation in mean monthly temperature (20.7-29.2°C) of native sites. It will not, however, tolerate frosts which partly explains its absence above 1,200 m in the native range. Whiteman *et al.* (1986) in southeast Queensland, found that trees became leafless when night temperatures fell below 15°C. *Gliricidia* can be managed as a coppice in areas with light frost, by cutting new growth before frosts occur.

The 30 sites sampled by Hughes (1987) in his range-wide collection of populations of *G. sepium*, represent a great diversity of soil types. Most soils were highly eroded, acid (pH 4.5-6.2) originating from volcanic parent material but also included sands, heavy clays and calcareous limestone soils which were slightly alkaline. At exotic locations, such as Peru, Szott *et al.* (1991) suggested that it was suitable for acid, infertile soils. Furthermore, Whiteman *et al.* (1986) considered *G. sepium* to be well adapted to low calcium soils in Australia, although it had poor survival on Indonesian soils with high aluminium saturation (Dierolf and Yost 1989).

A common feature of seasonally dry regions of Central America and Mexico is perennial fires which burn through fallow land and secondary forest. *Gliricidia* tolerates fires well and trees quickly re-sprout with onset of the rains. The increased frequency of deliberate burning may be responsible for its high occurrence in secondary vegetation and fallows.

Cultivation and management

Gliricidia sepium is commonly planted vegetatively and a full description of propagation methods is given in Glover (1989). The ease of propagation from stakes is a major advantage, especially as trees managed for leaf production with

frequent cutting may not flower and thus set no seed.

Gliricidia establishes readily from cuttings or 'quick sticks' and is ideal for shade trees, support trees or 'living fences'. Cuttings should be mature branches >7 cm in diameter which are brownish-green in bark colour. The cutting is normally cut obliquely at both ends, discarding the younger tips, and the base inserted 20-50 cm into the soil depending on the length of the cutting. Cuttings for live fences may be up to 200 cm long whilst those for hedgerows may be 30-50 cm in length. In Indonesia, cuttings are sometimes planted as close as 10 cm apart with alternate cuttings bent sideways at 45° and plaited onto upright ones. This makes a surprisingly strong hedge. In other areas, barbed wire is strained along the line of rooted cuttings and anchored to supported corner posts to make an equally strong fence. The hedges can be periodically pruned to provide fodder, green manure, firewood or stakes for new fences. Frequency of pruning depends on the environmental conditions for growth and the end use of prunings. Hedges around crops need to be pruned regularly to control shading.

It can be propagated by seed, usually sown in plastic sachets; the seedlings are usually cut back, as "stumps" prior to planting. The usual precautions to avoid seedlings drying out or being exposed to direct sunlight should be observed. No scarification or pre-treatment of seeds is required prior to germination, and germination rates above 90% are typical. Following germination, trees grow extremely quickly and may attain a height of 3 m before flowering at 6-8 months. Its rapid growth makes it an aggressive pioneer capable of colonising secondary forest and fallow *Imperata*-dominated grassland often forming dense, pure stands (Anoka *et al.* 1991).

Little is known about herbicides for use with tree legumes although Glyphosate (1 kg a.i./ha) and Simazine (1 kg a.i./ha) were effective and non-phytotoxic pre-emergent herbicides for control of grass and broadleaved weeds in *gliricidia*.

Ella *et al.* (1989) found that as plant spacing was reduced, yield per plant decreased owing to competition, but total forage yield per unit area increased, as did the leaf: wood ratio. They obtained the highest leaf yields at a planting density of 4 trees/m², the highest density tested. In hedgerow plantings, however, intra-row spacing seems to have little effect on overall yield, as lower individual tree productivity is compensated for by higher plant density. Atta-Krah and Sumberg (1987) recommended an intra-row spacing of 10 cm, but found only small differences in productivity for spacings ranging from 4 cm to 50 cm. In the same study, plants propagated from stakes were initially much more productive than those grown from seed, but by the fifth harvest (one year after the first) the difference was no longer significant.

The optimum frequency of lopping for leaf production depends on the local climate; clearly trees can be lopped more frequently in the wet than in the dry season. In general, total annual biomass yield increases with less frequent cutting, but as this also increases the wood:leaf ratio the effect of cutting interval on leaf yield is less pronounced. For gliricidia grown in the humid tropics and used only for forage, a cutting interval of 6-12 weeks is usually recommended.

Seed production

Gliricidia is largely outcrossing so it needs to be isolated from other trees of the same or related species to prevent cross-pollination. It should be planted in blocks containing at least 30 trees and isolated by at least 200 m. A border row should be established around the block and seed should not be collected from this row. Flowering begins at the start of the dry season and can continue in some native

populations until the end of March in Central America. Altitude was suggested by Hughes (1987) to exert a large influence on the onset of flowering with lower coastal sites flowering well before sites at higher altitudes (i.e. up to 1,200 m). The periodicity of pod ripening is partly dependent upon the climatic conditions and typically takes 45-60 days. *Gliricidia* grown in wet climates often flowers but sets little if any fruit.

To obtain maximum seed yields, trees need to have a good framework to maximize potential floral sites. Cutting *gliricidia* to 0.5 m after a seed harvest reduced flowering and seed yield in the following 2 years relative to an uncut control (Atta-Krah 1987). On-farm trials in dry-land farming in Bali showed that *Gliricidia sepium* as a multipurpose shrub producing fodder, cuttings, firewood and seed is best planted in clusters (Nitis, et al., 1997); for seed production it should be planted in alleys (Nitis et al., 1996).

In West Africa, Sumberg (1985) reported seed yields of *gliricidia* up to 89 g per tree per year, equivalent to approximately 37 kg/ha at the spacing used. Seed yield was closely related to the number of set racemes per tree. Seeds are shed from pods through explosive dehiscence with seed dispersal distances of up to 40 meters. Harvest is usually by collection of ripe pods before they dehisce, followed by drying in a site where seed from exploding pods can readily be recovered.

Crop use and grazing management

Gliricidia is lopped, not grazed. It re-sprouts vigorously after lopping and will tolerate repeated cutting. Moreover, its phenology is affected by cutting: re-sprouts retain their leaves in the dry season in the tropics when older shoots are deciduous. Management by lopping thus greatly enhances the value of *gliricidia* as a dry season forage. Values reported for *gliricidia* annual leaf dry matter production generally range from about 2 t/ha/year (Wong and Sharudin, 1986) to 20 t/ha/year (Sriskandarajah 1987).

Gliricidia is generally used as a high protein supplement to low quality basal feeds such as grass, straw and other crop residues. Supplementation levels vary but are usually in the range 20-40%. There are numerous reports of increases in weight gain and milk production in both large and small ruminants when *gliricidia* forage is used as a supplement. Nochebuena and O'Donovan (1986) reported that for Tabasco sheep in Mexico, both intake and dry matter digestibility increased when *gliricidia* was used as a supplement, up to 30% of the diet, with grass hay.

According to Preston and Leng (1987), the growth rate of steers in Colombia fed on King grass supplemented with *gliricidia* increased curvilinearly with supplementation level, with the highest growth rate at about 30% *gliricidia*. This result is in agreement with much of the research published to date, that about 30% is the level at which the *gliricidia* protein is most effectively used, in mixture with low quality basal feeds.

According to Lowry (1990), the only real constraint to its feed value for ruminants lies in its palatability. Animals seem to refuse *gliricidia* leaves on the basis of smell, often rejecting it without tasting it, which suggests that the problem lies with volatile compounds released from the leaf surface. A number of methods are used to increase its acceptability. These include wilting, addition of molasses or salt, and getting the animal used to it by prolonged exposure and/or penning with adapted animals. Wilting *gliricidia* leaves for 12-24 h before feeding is found to increase intake markedly in many of the areas where *gliricidia* is used as forage, and is therefore recommended wherever there are palatability problems. The reason for this effect is not known but if, as suggested above, acceptability is limited by

volatile compounds given off from the leaves, wilting presumably changes the composition of these volatiles resulting in a more acceptable odour. Differences in management do not fully explain the apparent differences in palatability. For instance, it is reported that in Sri Lanka gliricidia cannot be used as a hedge in goat pastures because of browsing of stems and bark as well as leaves, whereas in other areas, the animals will not even eat the leaves unless they are wilted.

In the Philippines, Perino (1979) found that it was seldom browsed by either wild or domestic animals. Other possible reasons for the variation in palatability in different parts of the world include climatic or edaphic effects on leaf chemical composition, differences in behaviour or in rumen flora between animals in different places (whether genetically or environmentally caused), or genetic variation in the gliricidia itself.

In Indonesia, fodder shrubs and trees have been used to overcome dry season feed shortages and a three strata forage system (incorporating *G. sepium*) has been developed in Bali to increase productivity in dry-land farming areas (Nitis et al., 1989).

Composition

There is varying opinion about the nutritive value of *Gliricidia sepium*. It is generally agreed that it is a high quality forage, but of low palatability when first introduced to animals. The smell of the leaves has been implicated in this initial reluctance of animals to eat gliricidia but, once adapted, there appear to be no long-term detrimental effects on sheep and cattle. Its toxic effects are well known in its native range in Central America, where the leaves or the ground bark, mixed with cooked maize, are used traditionally as a rodent poison (Standley and Steyermark 1946).

Feed Value and Digestibility

Crop improvement

This genus has not been collected to the same extent as *Leucaena*. There are considered to be only four species (Polhill and Sousa 1981), of which *G. sepium* (common name 'gliricidia') is the only species of real agronomic potential; it is only recently that an effort has been made to collect a representative range of its germplasm.

Oxford Forestry Institute has collected seeds of many provenances of *G. sepium* from Latin American countries (Hughes 1987). Tests in 147 sites across the tropics showed that Retalhuleu of Guatemala and Belen Rivas of Nicaragua performed better than other provenances (Simons and Dunsdon 1992). Trials in Nigeria (Cobbina and Atta-Krah 1992), in Australia (Bray et al. 1993) and Indonesia (Sukanten et al. 1995) showed that Retalhuleu and Monterio provenances of Guatemala and Belen provenance of Nicaragua grew faster and produced more fodder than the other provenances of *G. sepium*.

Gliricidia is cross-pollinated; seed supply is often a problem as seed set is sporadic and uncertain in environments without a marked dry season. However, since the usual method of propagation is by cuttings, this is a difficulty largely confined to experimental situations. One danger arising from vegetative propagation is the existence of large monogenotypic stands, with no inherent variation to combat new pests and diseases. Such a situation is undesirable, and efforts should be made to ensure diversity by planting from a wide range of clones. Even widespread

distribution of a single elite variety is perhaps best avoided.

Pests and diseases

Although widely grown throughout the tropics, *G. sepium* has apparently remained free of serious diseases. Recent surveys in Central America, however, noted the common occurrence of serious 'little leaf disease' (thought to be caused by a mycoplasma-like organism) in fence-line and natural populations.

Cercosporidium gliricidiasis, chocolate or brown leaf spot, is widely recorded on *G. sepium* throughout Central and South America, the Caribbean Africa, southeast Asia and the Pacific. Recent surveys confirmed its common occurrence in Honduras and Guatemala. Under humid conditions, it causes defoliation. *Colletotrichum gloeosporioides*, expressed as small, dark, rounded leaf spots, is more common than *C. gliricidiasis* in Nigeria. *Gliricidia sepium* was defoliated by *Cladosporium* sp. in Costa Rica and the pathogen has also been recorded in Jamaica and Venezuela Scab (*Sphaceloma* sp.), manifested as brown scab-like lesions on petioles and stems, was found for the first time on *G. sepium* in Honduras during recent surveys. Its relation to other legume scabs is being determined. Surveys have also found leaf scorch/scald and powdery black leaf spot at several sites. Investigations are in progress to determine the causal agents.

In some areas in Bali, Indonesia *Gliricidia* is infested with an aphid (*Aphis craccivora*) particularly at the onset of the rains, which causes blackening of the leaf surface and in severe cases the death of the leaf primordia and shedding of young leaves (Nitis et al. 1989). Evaluation of 16 provenances of *Gliricidia sepium* showed that 3 provenances (G14, G17 and N14) were quite resistant to aphid infestation (Nitis et al., 1991).

Links

- [Handbook of energy crops](#): *G. sepium* (Jacq.) Steud. uses, folk medicine, chemistry, description
- [FACT sheet on *G. sepium*](#): the quintessential agroforestry species.
- [A Multipurpose Forage Tree Legume](#): Chapter from a book on forage tree legumes
- [G. sepium \(Jacquin\) Kunth ex Walp.](#): general description, distribution map and habitat
- [Pacific Island Ecosystems at Risk \(PIER\)](#): description of *G. sepium*
- [Article](#): "Ciclaje de nutrientes en un banco de proteína de matarratón (*Gliricidia sepium*)".
- [CIPAV Foundation, Colombia](#) - Influence of *Gliricidia sepium* restricted grazing on liveweight gain of growing cattle in star grass pastures

References

[Anoka U.A. et al. \(1991\)](#); [Atta-Krah, A.K. \(1987\)](#); [Atta-Krah A.N. and Sumberg J.E. \(1987\)](#); [Bray R.A. et al. \(1993\)](#); [Cobbina J. and Atta-Krah A.N. \(1992\)](#); [Dierolf T.S. and Yost R.S. \(1989\)](#); [Dommergues Y. et al. \(1999\)](#); [Ella A. et al. \(1989\)](#); [Glover N. \(1986\)](#); [Glover N. \(1989\)](#); [Gutteridge R. C. and M. Shelton \(1998\)](#); [Holm L.G. et al. \(1979\)](#); [Hughes C.E. \(1987\)](#); [Lowry J.B. \(1990\)](#); [Nitis I.M. et al. \(1989\)](#); [Nitis I. M. et al. \(1991\)](#); [Nitis I.M. et al. \(1996\)](#); [Nitis I.M. et al. \(1997\)](#); [Nochebuena G. and O'Donovan P.B. \(1986\)](#); [Perino J.M. \(1979\)](#); [Polhill R.M. and Sousa M.S. \(1981\)](#); [Preston T.R. and Leng R.A. \(1987\)](#); [Seibert B. \(1987\)](#); [Simons A.J. and](#)

Dunsdon A.J. (1992); Sriskandarajah N. (1987); Standley P.C. and Steyermark J. A. (1946); Sukanten I.W. *et al.* (1995); Sumberg J.E. (1985); Szott L.T. *et al.* (1991); Whiteman P.C. *et al.* (1986); Wong C.C. and Sharudin M.A.M. (1986)