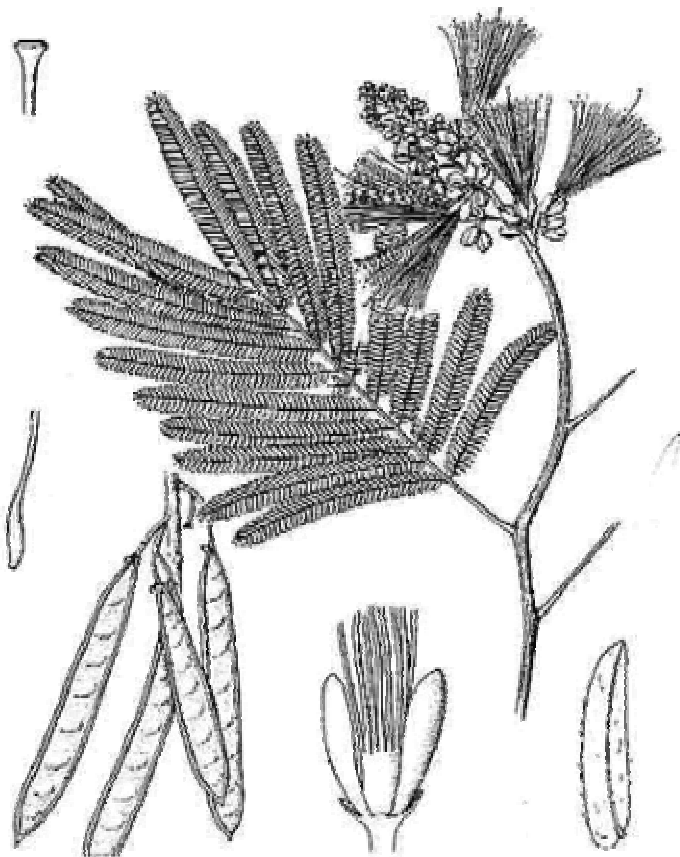


# Calliandra calothyrsus

## 1. Introduction and Main Uses

*Calliandra calothyrsus* Meissen. is a native of north-western Panama through to southern Mexico with native populations within Honduras, Costa Rica, Guatemala, Belize, and Nicaragua. The species belongs to the family Leguminosea and the sub-family Mimosoideae and being a legume demonstrates the positive features associated with soil improvement. The species is generally a small tree or shrub but can grow to about 12 m and develop a stem of diameter 20 cm. It is grown particularly as an agroforestry tree, since the species demonstrates fast growth, ease of establishment and ability to coppice. The leaves provide a valuable fodder and the nitrogen-fixing abilities of the root system mean that the species can be beneficial to the farming system. These qualities were recognised many years ago and the species was introduced into Indonesia in 1936, where today there is thought to be well in excess of 500,000 ha of the species growing.

Its main use has been as a food supplement to cattle and goats, the young shoots and leaves provide a valuable supplement to livestock and poultry. Because of its fast growth it has found favour in re-greening eroded sites and for the smothering of weeds and provided a light shade for other cash crops.. The wood is suitable as a fuelwood and it has proved to be a useful alternative to *Leucaena* and *Eucalypts*.



The leaves are complex, bipinnate leaves with the main rachis 10-17 cm, composed of pinnae of 4-7 cm in groups of 15-20 pairs. The pinnae are themselves made up of 25-60 pairs of leaflets measuring 5-8 mm long by 1 mm wide. The pods are 10-15 cm long, slightly curved and depending on the provenance each containing up to 15 seed. Each seed is ellipsoidal, flattened 5-7 mm long and dark brown in colour.

## **2. Site Requirements**

Looking at all the various provenances, the species has a possible rainfall tolerance of between 700 mm to 4,000 mm. In its natural environment in Central America, the species occurs between an altitude 0 – 1,850 m usually within secondary forest or disturbed areas. It is associated with wet tropical forest and with seasonally dry forest where there may be a dry season of 4-7 months. Of particular importance is its ability to tolerate acidic soils, it can be grown in areas with soils of pH 5.0-6.5 and is generally tolerant of a wide range of soil types. It is a good replacement for *Leucaena leucocephala* where the soils are tending towards the acidic end of the pH spectrum

In Sri Lanka it has been recommended for moderately dry sites, but not those subject to a long dry season.

## **3. Seed sources**

There has been a tendency for much of the international seed sales to be dependent on seed collected in Indonesia, due to the large areas that have been planted in that country. It is believed that much of this resources was established from seed which had been imported from a relatively small area of Guatemala; hence leading to a rather narrow genetic base. Some work has been done the international testing of provenances for Calliandra under the auspices of the former Oxford Forestry Institute. Under this trial, a total of 37 provenances were tested some of which were planted out in Sri Lanka at Doragala and at Pallekelle, though except for the Philippines, it was not tested in other parts of S.E. Asia. In terms of stem length, the provenance of Santa Maria from Cost Rica and two provenances from Belize performed extremely well on a wide range of sites. In addition all the Guatemalan provenances had above-average stem length growth. This was also reflected in the figures for wood production. For most sites the Guatemalan and the Nicaraguan provenances performed well.

For Sri Lanka, it was noted that growth (wood production) was superior at Doragala (420 m) compared to Pallekelle (1,450 m). The highest production (2.5 kg/tree) was seen in Plan del Rio provenance of Mexico, the San Ramón seed of Nicaragua and the Fortuna provenance of Costa Rica. The best growth in the higher altitude site of Pallekelle was considered to be from Plan del Rio and Union Juarez provenances, both from Mexico. At the same sites, in terms of leaf production, there was a similar result with Plan del Rio producing the most leaf production at Doragala (3.5 kg/tree) and again Plan del Rio and the Union Juarez provenances performing well for Pallekelle (3.0 and 3.34 kg/tree resp.). Overall the conclusion of the study were that the Nicaraguan provenances of San Ramon was the overall best bet in terms of reliability, it also performed well in Sri Lanka both in terms of wood and leaf production. It also appeared that the Indonesia collected seed also performed well overall, which is fortunate considering it has been widely used as a source.

Calliandra trees usually flower and bear fruit within a few years. The pods can be up to 18 cm long with 8-12 seeds per pod; the seeds are flat and oval an up to 8 mm in diameter. The number of seeds per kg varies from 14,000 -20,000 per kg and individual trees should be able to produce at least 100 g of seed. There can however be problems with seed production sometimes as a result of poor pollination. Calliandra is pollinated by insects and especially bats. Although it is normally for large amounts of flowers to be produced, they are only receptive to pollen for one night only and hence fruiting can be variable. The pods will explosively shed the seed for up to 10 m from the mother tree, hence seed collection has to be carefully timed. Seed which is extracted in a non-mature state is unlikely to be viable. Recommendations are for the near ripe pods to be laid out in the sun but under netting in order to keep the seed in a controlled area.

Where seed has to be purchased from external sources, some guidance as to seed suppliers and the quality of seed being supplied can be gained from the World Agroforestry Centre ([www.worldagroforestry.org](http://www.worldagroforestry.org)). Under the right conditions, the seed will store very well and does not lose viability, provided it is kept in air-tight sealed containers and not exposed to excessive temperatures. For long-term storage (5 years) then the seed should be stored at 4 C.

#### **4. Nursery Practice**

The seed will germinate without treatment, however it has been reported that overall germination can be greatly improved by simply nicking the outer coat of the seed. For small quantities this procedure is possible, but not for larger nurseries such a process is uneconomic. In such situations, germination can be improved by a pre-treatment of 10 minutes in water of 70 C followed by 24 hours in cold water.

Unlike *Gliricidia sepium*, it is not usual to propagate Calliandra from vegetative material, it can be established from cuttings, but seedling stock is the usual method.. In the nursery, it is normal to use container stock made from standard plastic sleeves or bags (layflat 7.5 x 10 or 10 x 15 cm ). Seeds can be directly sown into the tubes or an intermediate germination bed can be used, from which the germinated stock are pricked out into the tubes. The soil used for the containers should be freely draining (avoid heavy clays) ideally with a pH of between 6-8. Since Calliandra is a legume, soil inoculation with the right strain of Rhizobium is important if the crop is going to develop to its full potential. The inoculum can be applied directly to the seed prior to sowing using 50 g of inoculum, per kg of seed. Otherwise nursery soil which has the Rhizobium already in it can be used in the containers. Soil should be collected from areas where ideally Calliandra is already successfully growing (or if this is not possible another leguminous tree crop). This soil should be mixed into the standard nursery soil in a ratio of 1:10 to ensure adequate inoculation. It has been further reported that the growth of this species can be enhanced by an association with certain fungi. These fungi termed vesicular-arbuscular mycorrhizal (VAM) fungi. Species that have been mentioned include *Glomus velum* and *Glomus merredum*. There is an association between these fungi and a large number of plants. The fungal hyphae impregnate the root cells of *Calliandra* and other trees and arbuscules start to form approximately 2 days after root penetration. These are tree-like clumps of hyphae. Arbuscules are considered the major site of exchange between the fungus and

host. For the large-scale grower, attention ought to be taken to ensure that the nursery soil is suitably supporting a population of these fungi, for the casual, small grower such attention to detail is unlikely to be taken, but it would still be sensible to ensure that some soil is taken from a healthy stand of leguminous trees.

The seedlings grow quickly in the nursery and should have obtained a suitable size for planting out (20 cm) within 4 months, providing the nursery is subject to moderate-high temperatures

## 5. Site Preparation

The site should be cleared and prepared well in advance of the likely planting date. It should be prepared to agricultural standards with all competing weeds removed. If possible, the site should be ploughed and harrowed where there is the opportunity of having recourse to the use of agricultural machinery. Following the onset of the rains and the wetting of the upper 30 cm of soil, planting can commence. If tubed stock is being used, the plastic sleeves should be carefully split using a sharp knife to avoid distortion of the roots. When establishment is being made using cuttings a quarter of the stem should be inserted into the ground and firmed into position.

Planting pits of adequate dimensions to take the tube should be dug in advance of planting. For biomass production under a SRC management regime, the espacement will be of the order of 1 x 1 metres or 1 x 2 metres (10,000 – 5,000 sph). Where Calliandra is being established along with another crop in an agroforestry or mixed cropping management system, then the planting design will vary with the overall management objectives. In Sri Lanka Calliandra has been used under the SALT approach<sup>1</sup> for the contour hedges planted at 20 cm within the row and 6 metre between the rows. Under this regime, however, the main objective is to provide green manure and to stabilise the slope rather than biomass production per se. It has also been used under coconut crops at espacements of 50 cm x 4 metre, where again the main objective is to provide green manure to the overstorey. Where biomass is the main objective, then stockings in excess of 5,000 sph should be used.

## 6. Management Practice



Biomass Production. *Calliandra calothyrsus* demonstrates good coppicing ability and therefore for biomass production, this is the preferred method of management. The crop is coppiced at intervals of less than 4 years depending on the size of material required. In Sri Lanka, the material that is generally used is of a small diameter and is cut at intervals of a year or sometimes even more frequently. Coppicing at this frequency can not go on forever and replacement of the stools will be required after about 15-20 years, if productivity is to be maintained.

Calliandra in Sri Lanka (planted 1 x 1 m)

In addition, there is a danger that if the coppicing is carried out too frequently then too much of the growing energy is directed towards leaf production rather than useful biomass.

It is found to be beneficial if the first cut is carried out after just one year as this promotes the production of multiple stems and tends to improve overall productivity. Normally with coppicing, the cut is made at a height of around 20 cm; however in Sri Lanka, there has been found to be a good response to pollarding at waist height. The regrowth is then cut at short intervals as it reaches the minimum required size.

The wood has a medium density with a specific gravity of 0.5-0.8. It burns well, producing around 4,600 kJ/kg and can be used to make charcoal with a fuel value of 7,200-7,500 kJ/kg (conversion rate around 35%).

### Other Products

Calliandra whilst being grown for biomass as the main product will also provide substantial leaf material that can be used as a green manure or as an animal fodder. However when being grown as a green manure it is normal for the Calliandra to be grown within the main agricultural crop as a well managed hedge in order to limit competition both above and below ground cutting back the trees at frequent intervals. Prunings can be laid directly on to the soil as green mulch; incorporation into the soil is not reported to provide major advantages. In addition, through nitrogen fixation, the Calliandra will further improve the chemical condition of the soil, in which it is growing. The deep rooting nature of the species also allows the crop to act as nutrient pump, recycling nutrients more effectively. When grown as an understorey to coconut in Sri Lanka, it is reported to have increased the yield of nuts from 62.7 nuts/palm to 77.6 nuts/palm<sup>2</sup>.

### Animal Fodder

Calliandra has been found to have a valuable role in supplementing animal feed. The leaves and young shoots contain a high level of crude protein of over 20% (dry weight basis) and the leaves do not contain any toxic compounds. In this respect, Calliandra is to be preferred to *Leucaena leucocephalla*, which is much favoured as an animal feed but contains the extractive mimosine, which is mildly toxic to some animals when fed in excessive amounts.

Freshly harvested leaves of the species are highly palatable to ruminants, though less so when dried; however at normal supplementation levels (20-40%) there should be little problem with rejection of Calliandra. There are indications that high levels of tannins might make the leaves less digestible for livestock. It is fed routinely to goats and dairy cattle in Indonesia and has been well tested in Australia. Trials in Sri Lanka on feeding rabbits with a mixture of coconut oil meal and Calliandra indicated that there was little difference with good results for an equal combination of the two

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<sup>2</sup> Liyanage M and Abeysoma H.A. (1996). Management and utilisation of Calliandra calothyrsus in coconut plantations. Proceedings of International Workshop on the genus Calliandra. Bogor Indonesia. Quoted in Calliandra – A multipurpose tree for Agroforestry systems in Sri Lanka. ( H.P. Gunasena, I.P. Wickremasinghe and W.C. Wijenaikie)

forming up to 40% of their overall diet.<sup>3</sup> Trials in Zambia and other areas have illustrated the value of supplementing low quality feed with up to 35% dry matter with Calliandra. As a means of ensuring adequate increases in body weight for both sheep and goats. Further trails with poultry have suggested that for optimum improvement in egg production the level of supplementation should be kept below 5%<sup>4</sup>. Although Calliandra can be grown and managed for good effect for the provision of supplementary feed, it is not suitable for establishment within grazing areas, as the damage that is likely to be done to the bark leads to high mortality; it is possible however that with careful management of pollarding stock, that much of this potential damage could be limited.

## **7. Productivity**

Calliandra, although a popular fuelwood is usually not grown only for that purpose and figures on fuelwood productivity are consequently less complete than might be supposed. However production of the order of 25 t/ha/an have been obtained for this species in Indonesia based on the equivalent spacing of 10,000 sph and at the same spacing in Cameroon productivity was as high as 39 t/ha/an<sup>5</sup>. It can be expected that on the right sites i.e. within the rainfall range of 800 -3,000 mm and growing at an altitude of less than 1,500 m the productivity can be expected to exceed 25 t/ha/an and ought to be comparable to that of Gliricidia and Leucaena. Care should be taken with units of production. Yields of timber tend to be quoted in terms of m<sup>3</sup>/ha i.e. the amount of solid wood that is produced from a complete ha. When dealing with biomass and energy, it is more common to consider biomass in terms of (metric) tonnes/ha.

In terms of fodder production, in Indonesia, annual forage yields are reported to be of the order of 7-10 t/ha (dry matter), with fresh fodder yields as high as 46 tonnes in Western Samoa.

## **8. Income Generation**

Some estimates have been made for income generation from the growing of Calliandra in Sri Lanka. The species is clearly suitable as a component of a mixed farming enterprise, providing fodder for livestock and green manure for food crops. It has a particular role in SALT type land management. It is also suited to the small-scale farmer as an energy crop if a suitable market or collection point is within an economically acceptable transportable distance. Models have been derived for a range of potential farm conditions to provide guidance on the sort of returns that might be expected. These are appended to this information sheet. The variables that need to be considered by an individual farmer or association of growers are the following:-

1. Area of land that can be dedicated to energy crops. It is suggested that to make it a worthwhile exercise around 1 ha should be set aside for this activity.

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<sup>3</sup> Quoted in Gunasena, Wickremasinghe and Wijenaike (see above)

<sup>4</sup> Referred to in Tropical Forestry Paper 40, Oxford Forestry Institute.

<sup>5</sup> Quoted in Tropical Forestry Paper No 40, Oxford Forestry Institute, 2001.

Useful supplements to household income can be derived from small areas i.e. the collection of small diameter material from hedges, but this would only equate to a relative minor part of the total farm income.

2. Site productivity – a combination of factors related to rainfall, soil fertility and depth, altitude etc
3. Distance to collection point or market.
4. Reliability of the market - is the demand still going to be there in 5 years?
5. Is there sufficient spare labour either within the family or available for hire to meet the demands of establishment and harvesting. The table below provides an indication of the levels of labour that might be expected for the main tasks. One of the advantages of growing energy crops is that there is some slight room for modifying the calendar of activities to fit into demands for other crops.

## **9. References**