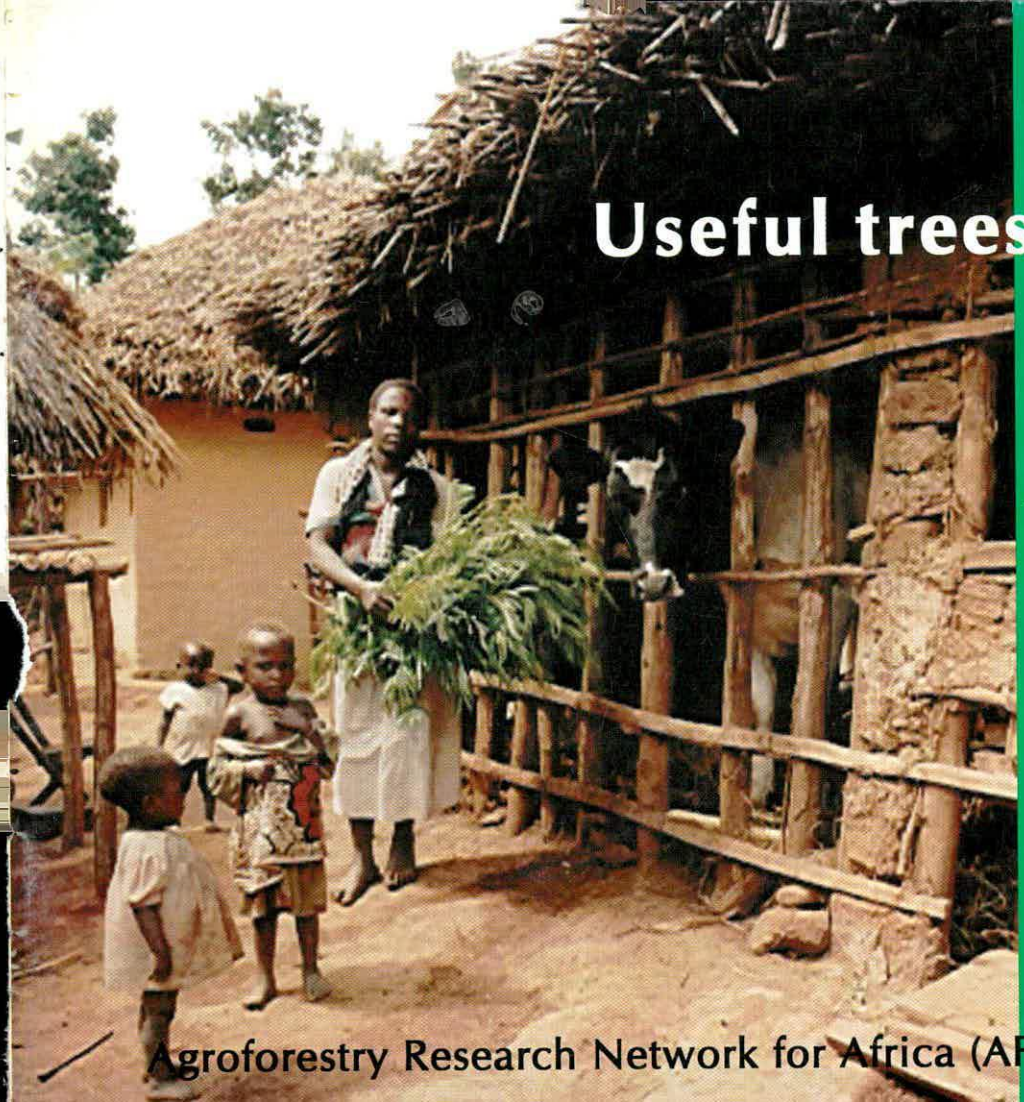


Useful trees for farming

CALLIANDRA calothyrsus

Agroforestry Research Network for Africa (AFRENA-Project Uganda)





International Centre for Research in Agroforestry.

The AFRENA Project-Uganda is jointly implemented by the Forestry Resources Research Institute (FORRI), of the National Agricultural Organisation (NARO), and the International Centre for Research in Agroforestry (ICRAF)



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INTRODUCTION

Calliandra, a shrub native of Central America, was introduced in Uganda and has been grown by many farmers for more than ten years. Farmers appreciate Calliandra because of:

- its fast growth even on poor soils and re-grows after cutting,
- its use in soil conservation,
- its excellent quality as supplementary fodder for livestock,
- its continous production of stakes,
- its fuel wood, and
- its ability to improve soil fertility.

Beekeepers appreciate Calliandra as a good source of nectar for the bees. Calliandra (the botanical name for the most commonly used specie is *Calliandra calothyrsus)* is a small leguminous tree of the *Fabaceae* family. In its native area, its flower has inspired farmers to call it "angles' hair". Bats or hawk moths pollinate the flower.

It occurs naturally in some parts of tropical Central America at altitudes ranging from sea level to 2000 m and where the annual rainfall is above 1000 mm. However, it does not grow well in regions with dry seasons extending 4 months. Calliandra tolerates a wide range of soil conditions, as long as the soil is not waterlogged or very acid (pH < 4.5). It grows in most southern areas of Uganda. It does not perform well in areas with only one rainy season. Like many other leguminous plants, e.g. groundnuts and beans, Calliandra lives in symbiosis with soil bacteria (called *Rhizobium*) that form nodules on the roots. Calliandra provides these bacteria with energy and the bacteria in return provide the tree with nitrogen that they can fix from the air (air consists to about $^3/_4$ of nitrogen).

Thereby benefiting both partners : the bacteria get energy and



D. Siriri

Root nodules on a Calliandra seedling





Calliandra is less dependent on the nitrogen in the soil (plants themselves cannot fix nitrogen from the air). Check the root nodules, if you cut them and when they are purple inside, they are likely to be active. Calliandra often nodulates well with the bacteria naturally available in the soil. However, it is advisable to inoculate seedlings when raising them *(see: raising Calliandra seedlings).*

It is important to note that little evidence has been found for a direct transfer of nitrogen from one plant to another. This implies that when Calliandra is grown in the cropland, the crops do not benefit directly from the shrub's nitrogen fixing. It is only when the nitrogen-rich leaves (and roots) decompose that the fixed nitrogen becomes available to the crop.



T.Raussen

Pods of Calliandra ready for seed harvest

DIVERSITY

There are a number of shrubs with similar qualities as Calliandra. Currently, some of them are under test, for example, Leucaena trichandra, Leucaena pallida, Acacia angustissima, Mimosa scabrella (for high altitudes), while others like Gliricidia sepium (below 1500 m.a.s.l) have been grown by farmers for some time. Leucaena leucocepha can no longer be recommended as it is severely affected by a pest, the Leucaena psyllid.

It would be very risky and also not supporting diversity to rely on Calliandra alone. Its use together with some other shrubs mentioned

Seed for seed orchards can be obtained through the AFRENA-Uganda project. (see contact at the end of the booklet)

above is recommended. Also the use of various provenances (see seed production) is a must.

SEED & SEEDLING PRODUCTION

A mature shrub of Calliandra produces about 50 grams of seed per year and one gram of seed contains about 15 seeds. If we assume that at least $^2/_3$ of the seed will germinate, the seeds from 1 shrub can produce 500 seedlings (50 x 15 x $^2/_3$). Fifty grams of calliandra seeds is about 3 matchboxes-full.

SEED PRODUCTION

Farmers are encouraged to allow not less than ten Calliandra shrubs to grow and produce seeds. It is a bad practice to continuously use the seed from one tree only (this may lead to inbreeding). Farmers should exchange seed with neighbours to ensure diversity of the seed. Establishing seed orchards is encouraged. Well-known seed sources should be used; e.g. the provenances "Patalul", "Embu" or "San Ramon" and records about the type and source of the seeds should be kept.

Plant a seed orchard of one provenance with not less than 30 trees. If seed orchards of several provenances are established in the same area, they should be at least 500 metres away from one another. Wide spacing of the trees at 3 x 3 steps (metres) provides for a high number of flowers and pods.

It takes about two years for the Calliandra trees to begin producing seed. When the seed trees grow too big, for example after five to eight years, they can be cut to knee height to encourage re-growth. This can be

REMEMBER

- **Each shrub of Calliandra can produce enough seed for 500 seedlings every year.**
- **Farmers should keep some trees for seed production.**
- **Establish seed orchards with more than 30 trees of a known good provenance.**
- **Harvest almost-dry pods in January/February and June / July.**
- **Dry the seeds and clean them.**
- **Store in a cool and dry place.**







orchard to ensure continuous seed production. The other sections are gradually pruned when the originally pruned part comes back into seed production.

SEED COLLECTION

Although seed quality is best when the seeds are harvested dry, in practice, this is difficult. When the pods are very dry, they split open explosively, scattering the seeds several metres away. To avoid this, almost-dry pods that have started to turn brown can be picked by hand and dried (preferably in a sack). Seeds must be dry to ensure good viability and germination. However, do not dry the seed at very high temperatures, e.g. in an oven or in full sun.

In Uganda, seed usually mature in dry seasons, for example, January / February and June / July.

Seeds can be sown immediately after drying. It can also be kept for several months. When stored in an airtight container and refrigerated at 4°C, they can even remain viable for at least 5 years.

RAISING CALLIANDRA SEEDLINGS

Pretreatment of the seed

Calliandra seed has a hard coat, but even when sown untreated it will germinate after about two weeks. To enhance germination, the hard seed can be softened immediately before planting by soaking the seeds in water. It is recommended that the seeds are soaked in cold water (room temperature) for about 24 hours. The soaking is complete once most of the seeds have swollen. The seeds should be sown immediately. Seeds should never be boiled as this kills them.

Alternatively, Calliandra can be inoculated at the seedling stage. The inoculant is mixed in water and poured on the young seedlings.

To ensure good nodulation of Calliandra roots with nitrogen fixing bacteria, it is recommended to inoculate Calliandra with *Rhizobium* bacteria. There are two ways of doing this:

- Procure commercial inoculant, for example from Makerere University,Faculty of Agriculture, Soil Science Department.

The powder is mixed with soil of the nursery bed. Once a nursery bed has been inoculated, it can be used over many years without any need to inoculate again.

- Another way is to collect soil from beneath a Calliandra stand that is known for good and active nodulation and mix it with the nursery soil.

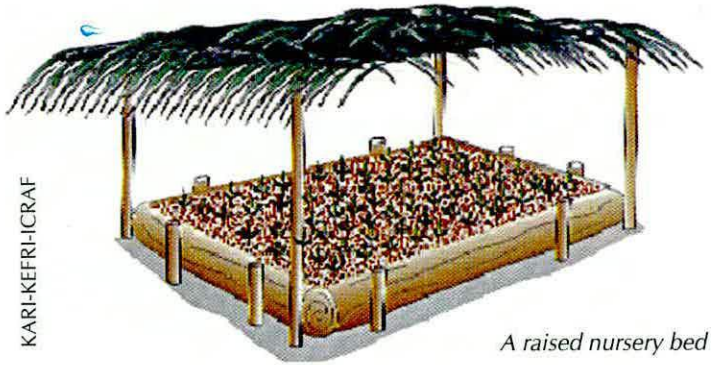
NURSERIES

Although direct sowing of Calliandra in the field is at times successfully done, most farmers prefer to raise seedlings in a nursery first. Direct seeding is usually more successful during the second rains, e.g. sowing in September. The inoculant can be mixed with the seed. Direct sowing requires sowing early in the season, particular attention and careful weed management until Calliandra has grown tall enough.

Calliandra seedlings should grow about 4 months in the nursery. The raising of the seedlings should be planned so that they are ready to set out in the field at the onset of the rains. Best planting time in southern Uganda is March and September. Hence the nurseries should be set up end of November and end of May.

The nursery should be near a constant source of water. Many farmers have their nurseries near the house where protection is easy and household waste-water can be used for watering.

In the past, Calliandra seedlings have often been raised in polythene bags. This is now only recommended if the seedlings have to be transported over long distances or if



KARI-KEFRI-ICRAF

A raised nursery bed

trees have to be established under harsh conditions. The disadvantages of seedlings in polythene bags are:

- Costs and often non-availability of the polythene bags;
- Losses and root damages when pricking out plants in the pots;
- More water and nursery space is required;
- Potted seedlings require much more space when carried to the field; e.g. it is easy for one person to carry 500 bare-rooted seedlings but not more than 25 potted seedlings.

Raising Calliandra is not much different from raising tomato or cabbage. Make a raised seedbed; similar to the ones used for vegetable nurseries. It should be about 1 foot high (30 cm).

REMEMBER

- Soaking Calliandra seed for 24 hours in cold water speeds up germination.
- Never boil seed.
- Inoculate nursery soil with commercial inoculant or soil from beneath well nodulating Calliandras.
- Start nurseries in May / June and in November / December.
- Best planting time in southern Uganda is in March and September.
- In most cases bare rooted seedlings are preferable.
- Calliandra nurseries are similar to vegetable nurseries.
- Good watering, weeding and shade management are important.
- Nurseries need good protection from livestock.

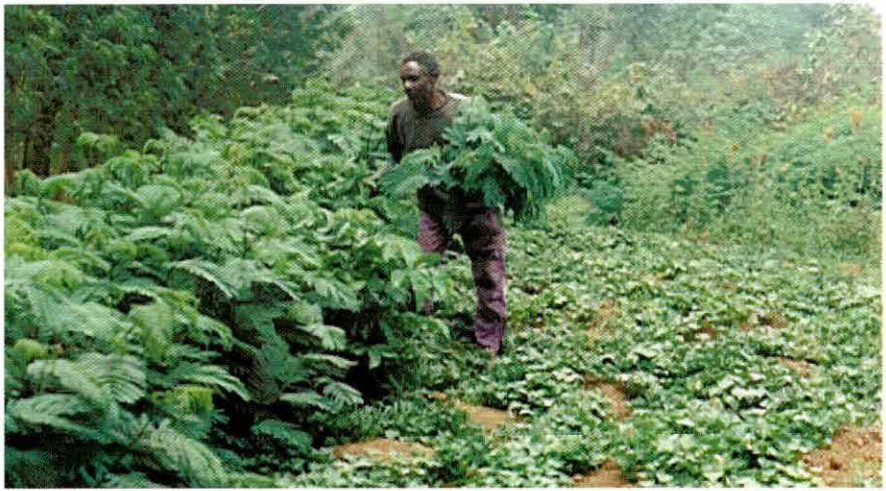


Regural watering of the nursery is important

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Use a mixture of good soil and manure. Broadcast the seed or plant in lines 10 cm apart. Cover with a thin layer of sand. The seeds germinate after 1 – 2 weeks. The plants should be allowed to grow in the beds until they are ready for transplanting to the field.

Water twice a day, in the morning and evening and reduce to a single watering in the last month before field planting. Regular weeding is as necessary as it is when raising vegetable seedlings. The seedbed should initially be shaded, but the shade should be removed gradually after 2 months. To harden the seedlings no shade should be provided during the last month before planting.



T.Raussen

From seed producing Calliandra, some seeds are likely to fall on the ground and germinate beneath the parent trees. Wildings produced in this way are very good for transplanting to the field. However, do not get all your seedlings from one isolated tree as this would lead to inbreeding.

CALLIANDRA FIELD MANAGEMENT

Planting

When your Calliandra seedling is of the right size (10-15 cm; about the length of your hand) and the rains are steady, wait for a cool, cloudy day to transplant. September and March are often the best months for transplanting.

Fodder harvest from a Calliandra hedge





Dig out the number of seedlings you want to plant the same day. Leave a lot of soil around the roots and carry the seedlings to the planting site.

Calliandra is often planted as hedges in single or double lines. Planted across the slope these hedges help to prevent soil erosion. Calliandra hedges can be planted together with crops.

Space between the seedlings should be $1^1/_2$ foot (50 cm) . A single line hedge of 500 Calliandra will be about 275 steps (250 m) long. If you prefer a double line, leave 1 step (90 cm) between the lines and plant again at $1^1/_2$ foot (50 cm) spacing within the line. 500 seedlings will give a double line of 148 steps (125 m) long.

Make planting holes deep enough so that the roots are not bent when planting. But also don't plant the seedling too deep. The roots should be in the soil but not the green stem of the seedling.

Applying 2 hands-full of well rotten manure or compost in the planting holes will improve initial growth of the seedlings. In case of a prolonged dry-spell, immediately after planting your seedlings in the field, watering will improve take-up and survival.



T.Raussen

Right size of seedling for transplanting

REMEMBER

- Only transplant seedlings of the right size.
- Transplant after a good rain at the beginning of the season.
- Use the right spacing; i.e. $1^1/_2$ foot between seedlings within a line and 1 step between lines.
- Don't plant your seedlings too deep!
- Weeding and protection from livestock are important for the young seedlings.
- Inform other farm laborers about the seedlings – if not, they may consider them as weed and uproot them!
- Water your seedlings in case of a prolonged dry-spell after trans planting.

Dairy farmers at times prefer to plant a so-called fodder bank near their zero-grazing unit. In such cases, the spacing should be one step (90 cm) between lines and $1^1/_2$ foot (50 cm) between seedlings within a line. 500 Calliandra would require an area of about 200 m^2 (e.g. 25 steps by 10 steps).

Some dairy farmers have combined these Calliandra fodder banks with their napier grass plantation.Various arrangements have been tried; e.g. 1 row of Calliandra followed by 2 rows of napier, or planting the Calliandra around blocks of napier, etc.

In the first season, your Calliandra will develop roots and not grow very fast. You will have to weed at least once per season. This is easy if Calliandra is grown together with crops.

Cattle, goats and other livestock like your Calliandra even when it is young and can destroy it. Keep them away from your Calliandra hedge! This again is easiest if a crop is grown next to your Calliandra.

MANAGEMENT

Cutting

Calliandra should first be cut when it has reached about the height of an adult person. This may be already in the second season. The first cutting should be low at about 1 foot above ground (30 cm) to induce the tree to spread at the base. Later cutting heights can be higher and depend on the desired products (fodder, stakes, firewood, and mulch material).

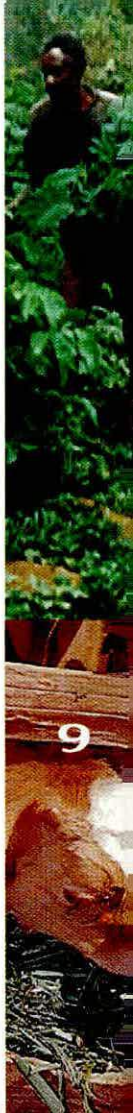
Maintenance of soil fertility

When a fodder stand is harvested frequently and the fodder removed, nutrients are extracted from the soil. These nutrients enter the digestive system of the animal and a large proportion is excreted through manure and urine. While Calliandra makes use of the air's nitrogen it requires the other nutrients as well. When Calliandra does not grow vigorously, some livestock manure and urine should be returned to the soil where the Calliandra is growing.

Diseases

Calliandra is relatively free of diseases and pests. However, some of the following might occur:

Root rot *(Armillaria mellea).* This





fungus affects roots in high altitude areas from which forest has recently been cleared. If the fungus is present in roots of other tree species and those roots touch the Calliandra roots, they get infected as well. The rot results in the death of the tree. Removal of old tree stumps and their roots minimises the occurrence of this disease.

Scales. These insects attack the stem and can kill the tree. Some scales appear white and powdery, others are smooth. The stem sometimes turns black. Scales are easily treated by spraying the affected areas with a washing detergent dissolved in water.

Rust *(Ravenelia spp).* These fungi usually appear on the underside of leaves, where they look powdery and occur as small raised dots.

Pink disease *(Corticium salmonicolor).* This disease is associated with intense coppicing.

Die Back *(Nectria ochroleura).* This fungus occurs in association with other fungal attacks. It causes general blight (discoloration of leaves) and sometimes cancers (swollen or sunken lesion in the wood.)

Viral or bacterial diseases have not been recorded on Calliandra.

Chemical control for pests and diseases is not recommended because of the negative effects the chemical residuals have on animals and the environment.

REMEMBER

- Let your Calliandra seedling grow to a person's height before cutting it at about 1 foot height
- Leave a few trees to grow for seed production.
- Later cut at about knee height (for stakes and firewood) or hip height for convenient fodder harvest.
- If Calliandra does not grow vigorously, apply some manure.
- Few pests and diseases attack Calliandra.



CALLIANDRA AS SUPPLEMENTARY FODDER FOR DAIRY CATTLE

Nutritive value

While grasses supply enough energy for the cow and milk production, they usually lack protein. Napier grass for example only contains about 8.5% protein (% crude protein of the dry matter) while Calliandra contains 20 to 25 %. Supplementing the feeding ration with Calliandra increases the overall protein content of the fodder ration (should be about 13% protein for dairy cows) and thereby increases milk production and butterfat content of the milk.

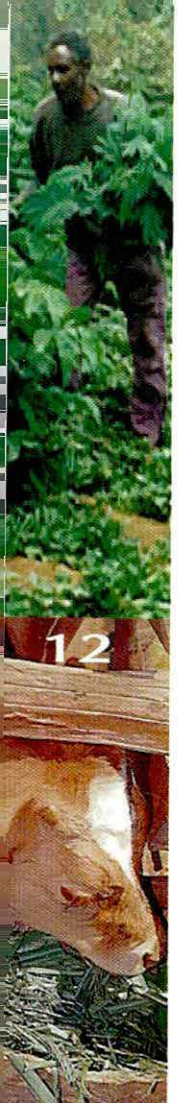
Cows will usually eat Calliandra stems up to a diameter of 1 cm when the stems are fresh or 4 mm (pencil size) during the dry season when they are woody.

Rations

For the farmer to obtain high economic returns, lactating cows with high milk-producing potential are normally fed protein-rich supplements like tree fodder. Calliandra







is used as a protein supplement. The basic diet normally consists of napier or other grass, weeds, crop residues (banana stems and leaves, maize stover, sweet potato vines), hay or straw. From on-station and on-farm experiments with dairy farmers, it has been concluded that 3 kg (1 basketfull) of fresh Calliandra fodder (1 kg dry matter) can replace 1 kg of dairy meal without affecting milk production. An additional 3 kg of fresh Calliandra increases the milk production by 0.6 kg, the same increment that is obtained from an additional 1 kg of dairy meal. In practice, this means that 6 kg of fresh Calliandra can replace 2 kg of dairy meal, when the farmer does not have money to buy the dairy meal. It is, however; preferable to feed Calliandra in addition to dairy meal, to fully utilise the potential of the cow.

Fodder harvesting intervals

A well-established stand of Calliandra can be harvested 4-5 times a year. During the height of the rainy season, the cutting interval can be as short as 2 months, but during the dry season, re-growth is slower, and the cutting interval may be as long as 4 months. A re-growth of 2 feet (50-60 cm) is a good indication that the tree is ready for the next harvesting. Some farmers reserve Calliandra mainly for dry-season feeding, when other protein-rich fodder is scarce.

DRY-SEASON FEEDING

The best way to conserve Calliandra for dry-season feeding is by leaving it uncut on the tree and harvesting it when it is needed. For optimum fodder availability, the trees should be pruned 6 months only in dry seasons to allow regrowth. At that pruning, a considerable amount of wood-fuel can be harvested as well.

The recommended cutting height is at about hip-height (1 m) above the ground (similar to the management of tea). When Calliandra is grown between food crops, however, a farmer might want to cut at a lower height (knee height) to minimise competition with the crops. Fur-

thermore, in such cases complete pruning should be done at sowing or first weeding of the crop to reduce competition.

The best way to cut the fodder is with secateurs or a sharp knife. This leaves a minimal wound and promotes fast and healthy re-growth. Breaking off the young shoots is also often practised by farmers. Calliandra can also be grazed, although this increases the mortality of the trees.

THE ECONOMICS OF CALLIANDRA AS A SUPPLEMENTARY FODDER

The extra income from the use of Calliandra is convincing. The example for the use of 500 Calliandra shrubs to supplement the fodder of one dairy cow with 6 kg fresh fodder every day over a lactation period of 10 months shows a relatively low investment in year one but good returns beginning in year two.

Even at a milk price of only 200 U Shs per litre, the net profit per year from a cow is still U Shs 64,500. This analysis does not take into account several other benefits of

AN ECONOMIC ESTIMATE

Relatively low investment costs:

❖ 25,000 UShs	if seedlings are bought	(500 seedlings @ 50 UShs)
❖ 3,000 UShs	labor for planting seedlings	(2days at 1,500 UShs)
❖ **TOTAL costs:**	**UShs 28,000 over 1 year**	

Good returns (per year):

❖ Extra milk (450 litres@300Ushs)	+135,000=
❖ Labor costs for feeding and cutting per day over 300 days	- 25,000=
	110,000=





Calliandra:

- It increases the butterfat content of milk and therefore its 'creaminess'.
- If used as a supplement, it may improve the cow's health and shorten the calving interval.
- While producing fodder, it also provides firewood, fencing, boundary marking, soil erosion control, and stakes for climbing beans.

Nor does the analysis include the slight competition between a Calliandra hedge and crops growing adjacent to it.

Calliandra for other livestock

Calliandra can be fed to dairy cattle, local cattle, goats, sheep, rabbits and poultry. For ruminants, 3 kg of fresh Calliandra can replace 1 kg of concentrates. The amount of Calliandra fed is normally $^1/_4$ to $^1/_3$ of the total diet. Rabbits are best fed on a mixture of weeds, grains and tubers (not fresh cassava), with $^1/_3$ of the daily diet consisting of Calliandra. Feeding on Calliandra alone causes weight loss. Poultry can be supplemented with dried Calliandra although this tends to increase feed intake and reduce egg production. The exact reasons for this are not known. A little bit of dried Calliandra mixed with layers mash (a small handful to 1 kg of layers mash) improves the colour of the Yolk without affecting egg production. It is anticipated that Calliandra is not very digestible for pigs, although this has never been tested.

REMEMBER

- Always feed Calliandra fresh
- Feed 3 kg fresh leaves (about 1 Ekitebo-full) of Calliandra in the morning and 3 kg in the evening.
- This will result in about 1.5 liters extra milk per day.
- 500 shrubs are required to produce such food for 1 cow.

Calliandra for stake production:

Due to the declining yield of bush beans a consequence of mainly bean root rot disease - farmers in many areas now prefer climbing beans which can give up to 3 times

the yield of bush beans. However, good production of climbing beans requires one stake for every 2 bean plants, i.e. 4 stakes per square metre or 320 stakes for a 10 steps by 10 steps (9 m * 9 m) plot!
Stake production is simple:

- Calliandra produces good stakes from its coppices every 10 to 12 months.
- At least 4 stakes are expected per stem of Calliandra. This means that, if planted as a hedge with 50 cm between the Calliandra, each metre of hedge would produce 8 stakes per year, enough for 2 m^2 (about 2 steps by 1 step) of a climbing bean field.
- The Calliandra stakes last for 2 to 3 seasons after which they can be used as firewood.

As a rule of thumb on stake production, farmers require 1 Calliandra bush for every square metre (1 step by 1 step) of climbing beans they wish to plant. After one year these stakes can be used for firewood and fresh ones can be harvested.



T.Raussen

Stakes for climbing beans from Calliandra

Important note: Hedges left for stake production will compete with crops particularly in the second season of the stake growth. They should therefore not be placed in the most fertile part of the field where competition would affect the best crop.

Calliandra for firewood production

Most farmers use firewood for their cooking. The amount of firewood used may differ a lot between households, but on average, 15 sticks (equivalent to 15 kg) are used per household per day.

Calliandra can provide good firewood that burns well with little





smoke.

- An average hedge of Calliandra spaced at 50 cm will provide about 6 kg of firewood per metre per year. Or, per day a household will need the firewood from 2 to 3 steps of Calliandra hedge.
- Calliandra also grows well on the usually infertile upper parts of terraces in the Kigezi Highlands. Farmers have established Calliandra on the upper part of terraces as rotational woodlots. After two years, the Calliandra will be about 5 metres tall and 2.5 kg of dry firewood are expected per square metre, i.e. from a 3 step by 40 step (100 m^2) plot 250 kg of firewood can be obtained (sufficient to meet a household's firewood demand for 3 weeks).
- When these woodlots coppice they can be harvested annually and one expects 1.25 kg of dry firewood per square metre, i.e. from a 3 steps by 40 steps (100 m^2) plot 125 kg of firewood can be obtained (sufficient to meet a household's firewood demand for 10 days).
- Farmers consider Calliandra not suitable for pole production.

REMEMBER

- Each Calliandra shrub can produce at least 4 stakes per year.
- The stakes can be used for 2 to 3 seasons and then be used for firewood.
- Calliandra hedges for stake production should not be placed where crop production is best.
- Firewood from Calliandra burns well and with little smoke.
- Firewood from Calliandra can be produced in many ways: as product from hedges, rotational woodlots or even from used stakes.

Calliandra for soil management

Calliandra has been widely used for soil management, particularly for soil and water conservation, through hedges planted across slopes along the contour lines. The shrubs should be spaced not more than $1^1/_2$ foot (50 cm) apart. These hedges can be combined with tall trees, e.g. Grevillea.

In most hilly areas, soil and water runoff during heavy rain storms present a big loss to farmers since crops lose moisture and nutrients for their production. It has been found that tree hedges planted across slopes have beneficial effects in two ways:



T.Raussen

Planting bare-rooted seedlings in a contour hedge.

(1) They present a physical barrier to the runoff, and gradually lead to the deposition of soil and to progressively forming terraces.

(2) Infiltration of water under the hedges is greatly increased and water running down a slope is "trapped" and will infiltrate.

The increased infiltration is mainly a result of the hedges' root activities and increased organic matter.

The steeper the slope, the closer the hedges should be spaced. Most farmers space their hedges between 4 and 10 steps apart.

Hedges are also important to stabilise terrace risers which otherwise collapse easy. A hedge of Calliandra can be planted at the lower edge of terraces and the roots will help stabilising it.

Important note: Trees or shrubs planted together with crops in the field will compete if not managed properly. Competition is also common for nitrogen





fixing trees. Therefore, it is important that hedges are pruned regularly to reduce competition with crops.

Calliandra as a mulch

On average one kg of dry Calliandra leaves contains about: 30 grams nitrogen, 10 gram phosphorous and 2 grams potassium.

Experience shows that Calliandra twigs and leaves decompose slowly and do not release nutrients fast. Calliandra mulch, therefore, has a slow long-term effect on soil nutrients, but improves soil structure and organic matter content. Calliandra is not usually recommended for biomass transfer.



B.Amwine

Terraces forming uphill of 8-year old contour hedges.

Rotational woodlots with Calliandra

Unlike for biomass transfer, rotational woodlots with Calliandra have shown to improve soil fertility substantially. In Kabale district, they have been particularly effective to restore soil fertility on the degraded upper parts of terraces. However, the technology is still under experimentation. Calliandra is planted at 2 steps between lines and $1^1/_2$ foot (50 cm) within the line. In the first two seasons, inter-cropping is possible. Thereafter, the canopy of the Calliandra will close. The trees are allowed to grow for two to three years before they are cut at about 1 foot (30 cm) above ground, shortly before the growing season. The litter and the root activities will have improved the soil, while the wood can be used for firewood or stakes.

After the cutting, crops can be planted in between the tree lines,thus benefiting from the increased soil fertility. While inter-cropping, the shoots of the Calliandra have to be kept short (by breaking them off). This can be done

for several seasons. At any time however, farmers can decide to allow the Calliandra to grow tall again for wood production and soil fertility improvement. The inter-cropping has to stop.

REMEMBER

- To use Calliandra for soil and water conservation they have to be planted closely (less than $1^1/_2$ foot) in lines across the slope "contour hedges".
- The contour hedges need to be pruned regularly to avoid competition with adjacently grown crops.
- Mulch from Calliandra releases nutrients slowly but improves soil structure and soil organic matter.
- Farmers' experiments of rotational woodlots with Calliandra on infertile land show excellent wood production and restoration of soil fertility. Again, management of the coppices is crucial when intercropping the woodlots.

GLOSSARY

Biomass transfer: The removal of biomass from –usually leaves and twigs–growing plants and its application at some other site to the soil as mulch.

Contour: Linear demarcation of the land surface that indicates places of equal elevation.

Contour hedges: Hedges of trees, shrubs or grasses that follow the contour.

Hedge: Bushes or shrubs or trees planted in a row and trimmed.

Infiltration: The downward entry of water into soil or other material.

Rotational woodlot: Woodlots of coppicing tree species which are inter-cropped with crops after felling the trees and before canopy closure of the coppices.

Woodlot: A small plot of trees grown for fuelwood, which can also provide small timber, poles and stakes.







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