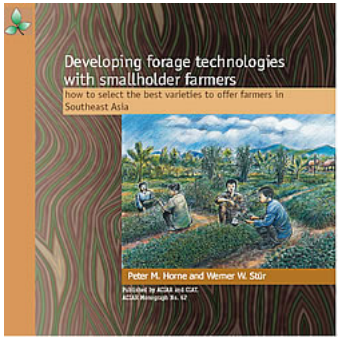

Developing forage technologies with smallholder farmers:

how to select the best varieties to offer farmers in Southeast Asia

Peter M. Horne and Werner W. Stür

(1999).

ISBN 1 86320 271 4

Published by ACIAR and CIAT.
ACIAR Monograph No. 62

Contents:

The Forages for Smallholder Project (FSP)

The Forages for Smallholders Project (FSP) is a Southeast Asian regional program funded by AusAID that commenced in 1995. It is managed by CIAT (Centro Internacional de Agricultura Tropical) and by CSIRO Tropical Agriculture (Commonwealth Scientific and Industrial Research Organization of Australia). The FSP is

a network of smallholder farmers, development workers and researchers in Indonesia, Lao PDR, Malaysia, Philippines, Thailand, Vietnam and southern China. The focus of the project is to develop forage technologies in

partnership with smallholder farmers in upland areas, where forages have potential to improve livestock feeding and management of natural resources.

Acknowledgments

This booklet is based on the experiences of researchers and farmers working with the AusAID-funded Forages for smallholders project (FSP) in Southeast Asia. This project is a partnership of smallholder farmers, development workers and researchers who are using participatory approaches to developing forage technologies on farms (see inside cover for details). More than 600 forage varieties were evaluated by FSP partners, including varieties selected by national programs and varieties from germplasm collections cf CIAT (Centro Internacional de Agticultura Tropical) and CSIRO (Commonwealth Scientific and Industrial Research Organization of Australia). This work would not hove been possible without access to these extensive forage germplasm collections. All of the forages included in this booklet are being used by smallholder formers and have significant potential for improved livestock production and natural resource management.

Many people have contributed to the development and production of this booklet. Special thanks go to the partners of the FSP including Le Van An, Perla Asis, Le Hoa

Binh, Wong Choi Chee, Francisco Gabunada, Liu Guodao, Bryan Hacker, Heriyanto, Ibrahim, Tatang Ibrahim, Peter Kerridge, Truong Tan Khanh, Elaine Lanting, Eduedo Magboo, Willie Nacalaban, Ganda Nakamanee, Chaisang Phaikaew, Phonepaseuth Phengsavanh, Vanthong Phengvichith, Viengsavanh Phimphachanhvongsod, I. Ketut Rika, Tugiman and Maimunah Tuhulele. The original introduction and evaluation was conducted by Bert Grof. Early evaluations on-farm were supervised by Trevor Gibson and Arthur Cameron.

Thanks are due to Arthur Cameron, Bruce Cook, Bert Grof , Michael Hare, John Hopkinson, John Miles and Max Shelton who provided comments on the draft of the booklet. We also thank Albert Borrero for preparing the layout and Ian Partridge, Nathan Russell and Julio Martínez for their layout ideas. Photographs were supplied by Jim Holmes, Alan Pottinger, Emma Louie Orencia, Lingkod Sayo, Wong Choi Chee, Michael Hare, Werner Stür and Peter Horne, and are credited with their initials. Cartoons were drawn by Dave Daniel and the cover drawing is by Kongphat Luangrath.

We also thank CIAT CSIRO, the Department of Livestock Development (Thailand), Oxford Forestry Institute, and other national and international programs in Southeast Asia, Latin America and Australia for providing the information and seed which was essential to running this forage evaluation and development program in Southeast

forage evaluation and development program in Southeast Asia.

The publication of this booklet has been generously funded by ACIAR.

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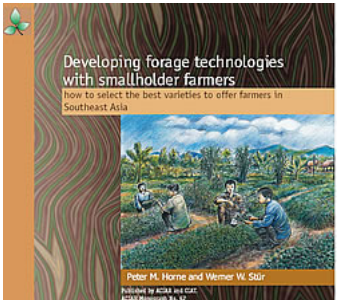
ISBN 1 86320 271 4

Home, P.M. and Stür, W.W. (1999). Developing forage technologies with smallholder farmers - how to select the best varieties to offer farmers in Southeast Asia. ACIAR Monograph No. 62. 80pp.

Design and layout by Albert Borrero, IRRI, Los Banos, Philippines.

Cartoons by Dave Daniel, Australia.

Cover illustration by Kongphat Luangrath, Lao PDR.



Before you start ...

What are forages?

Forages are grasses, herbaceous legumes and shrub/tree legumes that can be used for feeding animals. They can also be used for better management of natural resources including erosion control, soil fertility improvement and weed control. This booklet

emphasizes forages that are being used successfully by smallholder farmers. Often they provide multiple benefits.

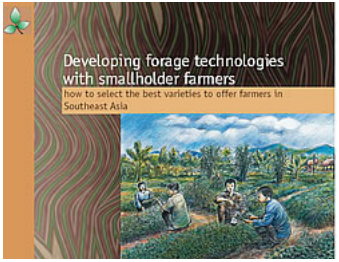
Why is this booklet needed?

Livestock are an important component of upland farming systems in Southeast Asia. In the past, feed resources were plentiful. On many farms this is no longer the case, so farmers have to spend more and more time finding feed for their animals. Planting forages can help to overcome this problem. However, no two farms have the same resources and needs. Forages that are suitable on one farm may not be suitable for other farms. The best way to develop the 'right' forage technologies for each farm is for farmers to evaluate promising forage technologies and adapt the best options to their situation.

In this participatory approach the role of the development worker is to give farmers information about forages that may solve their problems. There are many forages and ways of growing them on farms. Not all will be suitable for a particular situation and need. This booklet will

help development workers to select appropriate forage options to offer farmers.

This booklet does not attempt to list all species and varieties that could be grown. It contains only those that grow in a wide range of conditions and either are being used successfully by smallholder farmers or have significant potential in Southeast Asia. Details on management and utilisation of these species can be found in another booklet in this series 'Developing forage technologies with smallholder farmers - how to grow, manage and use forages'.



How to evaluate forages with farmers...

When offering forages to farmers, it is important to:

1. **Understand farmers' needs.**
2. **Choose suitable ways of growing and using forages.**
3. **Choose forages that are best adapted to climate and soil.**
4. **Offer farmers the best varieties, not just any variety of a species.**
5. **Offer a basket of choices.**

1. Understand farmers' needs

1. Understand farmers' needs.

Not all farmers need forages. Sometimes there is enough naturally occurring feed to meet the needs of their animals. Only those farmers who perceive a real need will be motivated to evaluate forages and adapt them to their specific situation. Another booklet in this series, 'Developing agricultural solutions with smallholder farmers - participatory approaches for getting it right the first time', describes ways of working with farmers to identify needs and to find solutions.

When we know the farmer's particular problems, we can choose suitable ways of growing and using forages that will provide the best solutions.

Working with farmers to evaluate forages in northern Laos (JH)

2. Choose suitable ways of growing and using forages.

Useful ways of growing and using forages to solve particular problems are described below. It is important to work with farmers to understand which of these options may meet their needs and best fit into their farming systems.

Cut and carry plots (WS)

Cut & carry plots

- **provide easy access to cut feed**
- **concentrate manure near the house for easy collection**

Grazed plots

- **a simple way of feeding animals if land is available**
- **need to be fenced to keep other**

grazing animals out

Grazed plots (WS)

Living fences

- **keep animals out of crops or forage plots**
- **provide a high protein feed supplement**

Living fences (WS)

Hedgerows

- **grown along the contour in sloping lands reduce run-off and erosion**
- **can also be grown along fence lines or between fields**

Hedgerows (WS)

Improved fallows

- **legumes grown in crop land which is left fallow for one or more years**
- **restore soil fertility and suppress weeds**

Improved fallow (WS)

Cover crops in annual crops

- **legumes grown with annual crops such as maize or cassava**
- **suppress weeds, improve soil fertility and reduce erosion**

Cover crops in annual crops (PH)

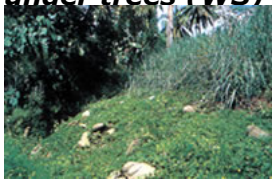
Cover crops under trees

- **legumes grown under trees such as fruit trees, bananas and coconuts**
- **suppress weeds, improve soil fertility and reduce erosion**

Cover crops under trees (WS)

Ground covers for erosion control

- **competitive, often stoloniferous grasses and legumes**
- **provide ground cover, reduce erosion and suppress weeds**



erosion and suppress weeds

Ground covers for erosion control (WS)

Legume supplementation for the dry season

- **high-protein legumes allow animals to utilise low-quality feed more efficiently**

Legume supplementation for the dry season (WS)

Legume leaf meal

- **dried legume leaf can be stored and fed to animals, especially chickens and pigs, as a high-protein supplement**

Legume leaf meal (WS)

The forage varieties best suited for each of these forage systems are listed in Table 1 of Section 3.

3. Choose forages that are best adapted to the climate and soil

No forages will grow well everywhere. Some grow well on acid soils; others do not. Some grow well in cool areas; others do not. Forages can survive in areas where they are not adapted but they will not grow well. It is important to choose forages that are adapted to local soils and climate.

Important climate and soil factors affecting forage adaptation are the length of dry season, temperatures, soil fertility, soil pH and drainage. The adaptation of species to climate and soils is shown in Section 3 (Table 2 and 'Special considerations') and Section 4 'More about each species'.

4. Offer the best varieties to farmers, not just any variety of a species!

There are many forage species and each of these can have one or more varieties. A good example is the species *Brachiaria brizantha* (see Figure 1) which has

three varieties. One of the varieties, 'Serengeti' is quite short and forms a sward (similar to the variety 'Basilisk' of *B. decumbens*) while the other two varieties of *B. brizantha* are tall. They also flower and produce seed at different times of the year

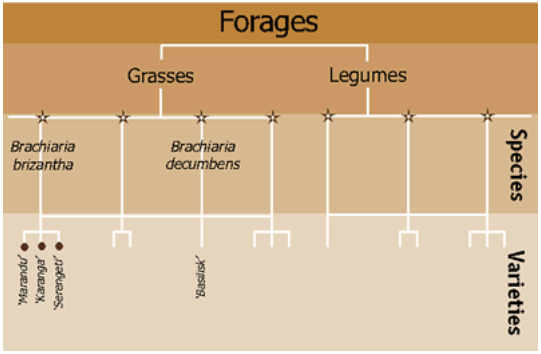


Figure 1: What are species and varieties?

Varieties are selected for special characteristics, such as growth

habit, time of flowering, high seed yield, disease resistance and tolerance to water logging. New varieties are being released all the time to overcome particular problems. For example, the species *Brachiaria decumbens* currently only has one variety ('Basilisk'). This variety grows well in Southeast Asia but seed production is poor in many areas. New varieties of *Brachiaria decumbens are* being selected to overcome this problem. It is important to offer farmers the best varieties, not just any variety of a species!

How do we identify different varieties?

Research organizations in different countries give each variety their own identification number. For example, *Arachis pintoi* ' Amarillo ' was given the number CIAT17434 by CIAT, CPI 58113 by CSIRO and BRA 013251 by EMBRAPA in Brazil . Only when a country releases a variety commercially, it is given a 'cultivar' name. If a variety is released in many countries it can have many cultivar names. For example, *Arachis pintoi* ' Amarillo ' was given the name cv. Amarillo in Australia , cv. Mani Forrajero Perenne in Colombia and

cv. Pico Bonito in Honduras .

Some of the varieties recommended for Southeast Asia did not have names but only identification numbers which are difficult to remember. Through con sultation with national forage research and development organizations in Southeast Asia , each recommended variety has been given a name. These names are based on existing cultivar names (eg. ' Amarillo '), common names (eg. 'Gamba'), the name of the location where the variety was collected (eg. 'Serengeti') or the name of the area where the variety is widely used (eg. 'Besakih'). A Table relating these variety names to identification numbers and showing the country of origin of the variety is included in Section 5 'Appendices'.

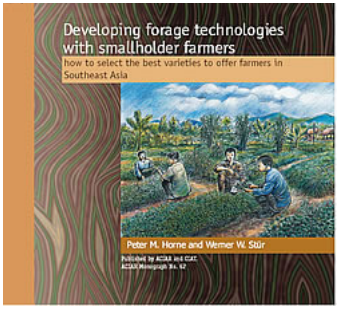
5. Offer a basket of choices

When farmers begin to evaluate forages, make sure you

- offer a range of species and varieties, not only one or two 'favoured' varieties.
- do not offer too many choices at any one time. It is difficult for farmers to evaluate a large number of new varieties. In most cases 4 to 8 varieties is ideal.
- plant small areas of each variety

  before expanding to larger areas. It is better to work with many farmers who plant small areas rather than a few farmers who plant large areas.

Offer a basket of choices (PH)



How to select the best forages ...

To select the best forages to offer farmers for evaluation, follow these steps:

Step 1 Use Table 1 to choose species which are suitable for the ways farmers want to grow and use them.

Step 2 Use Table 2 to find out which of these species are recommended for different climates and soils.

Blank cells in Table 2 mean that this species is not adapted to this climate or soil. Species receiving two marks (●●) are the first choice for testing in this situation. Those with one mark (●) may also be suitable but are not likely to grow as well as those

with two marks (●●). For example, *Brachiaria humidicola,* will grow well in fertile soils but received only one mark (●) as there are other species, such as *Panicum maximum,* which will grow better in these soils.

Step 3 Check the section on 'Special Considerations' to see if any apply to your situation.

Step 4 Read the descriptions of each species (see Section 4 'More about each species') you selected and identify varieties to offer to farmers for evaluation.

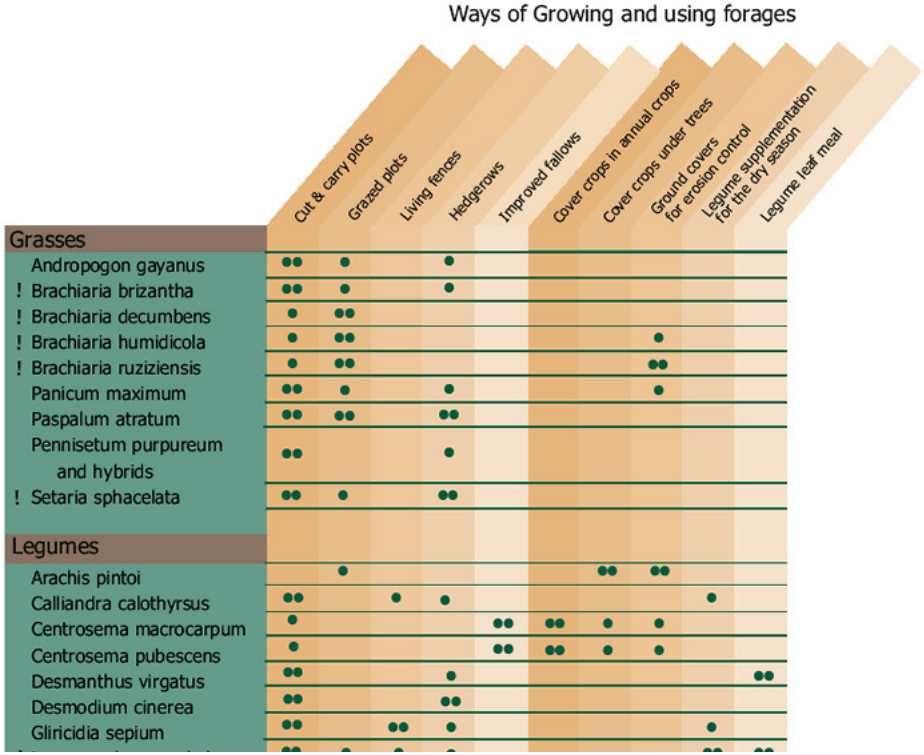
These 4 steps are only a guide to make it easy for you to start selecting forages. If you prefer you could use Step 2 before Step 1. As you become familiar with the information in this booklet, you

will find it easy to select species to offer farmers for evaluation.

Section 3 only lists major forage species. Other potentially useful forage species and varieties,

which may be useful in special situations, have been included in Section 4 '[More about each species](#)...'.

Table 1: Suitability of forages for different uses



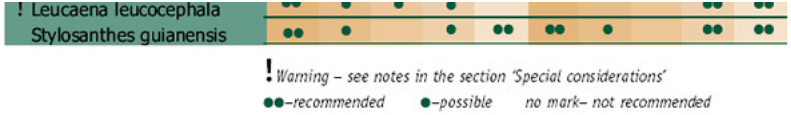
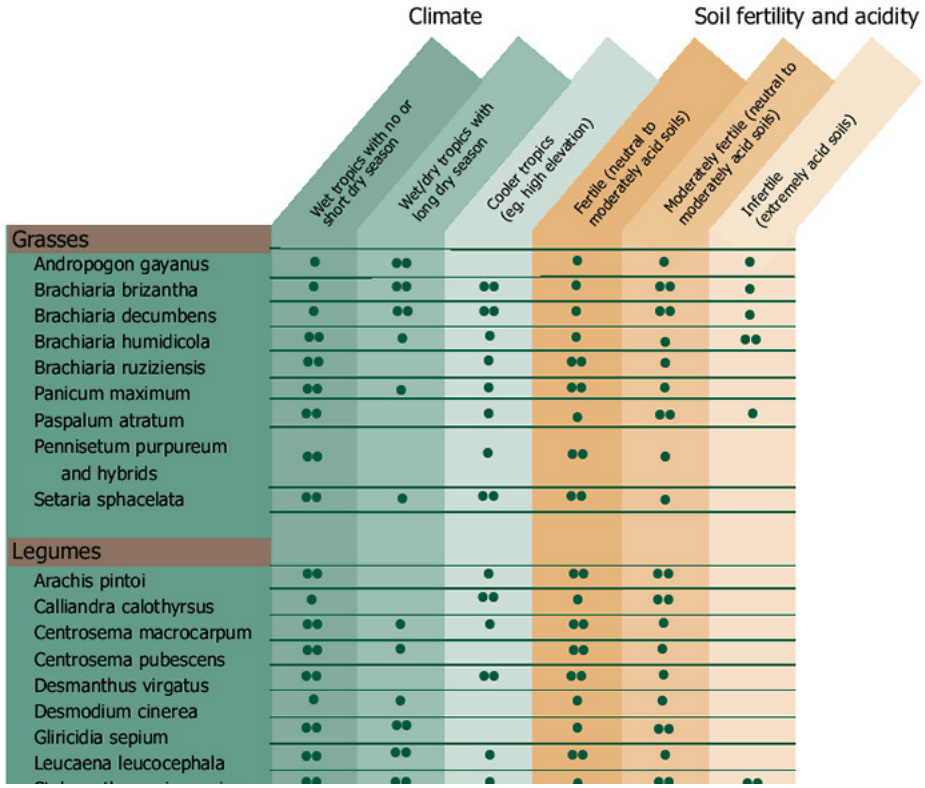


Table 2: Recommended forages for different climates and soils



Stylosanthes guianensis

●●–recommended ●–possible no mark– not recommended

Special considerations

In addition to the information presented in Tables 1 and 2, there are particular situations which require special consideration when selecting forages to offer farmers:

Forages for sheep, goats and young cattle

Do not feed *Brachiaria brizantha, Brachiaria decumbens, Brachiaria mutica* or *Brachiaria ruziziensis* to sheep, goats and young cattle. If fed large amounts, these animals can suffer from photosensitization which often results in death. *Brachiaria humidicola* can be fed to sheep, goats and young cattle but only in small quantities

Forages for monogastric animals

Some species can be toxic to monogastric animals when fed in large amounts. *Setaria sphacelata* can be toxic for horses, since it contains oxalates. *Leucaena leucocephala* may be toxic to monogastric animals, since it contains the chemical compound mimosine. It is generally recommended that the diet of monogastric animals should contain no more than 10% of *L leucocephala.*

However, it can be fed in large amounts to ruminants (eg. cattle and goats) since they are able to break down mimosine in the rumen.

Forages for shaded areas

Most forage species will grow as well in lightly shaded areas (such *as* under old coconuts) as

they do in open areas. Species which are often used for grazed plots in light to moderate shade are *Brachiaria humidicola, Stenotaphrum secundatum* and *Arachis pintoi.*

Farmers occasionally ask for forages to grow in heavily shaded areas. There are no species that will produce high yields in such situations, but some species are better adapted to surviving in moderate shade. *Arachis pintoi, for* example, can be used as a ground cover to suppress weeds in shaded areas. Other species that can survive in moderate shade are *Centrosema pubescens, Centrosema macrocarpum, Paspalum atratum, Panicum maximum, Setaria sphacelata, Brachiaria brizantha, B. decumbens, B. humidicola* and *Stenotaphrum secundatum.*

Forages for areas with a long dry season

Forages need water to grow, keep cool, and to take up nutrients from the soil. While there are no miracle forages that are productive throughout a long dry season, some species are better adapted to dry environments than others (see Table 2). Some tree and shrub legumes, such as *Leucaena leucocephala,* have root systems that can reach moisture deep in the soil. This allows them to grow and retain their leaves longer into the dry season than other forages. Some grasses and herbaceous legumes, such as *Andropogon gayanus* and *Stylosanthes hamata, are* also able to maintain green leaf long into the dry season.

Forages for acid, infertile soils

All forages grow well on fertile or moderately fertile soils.

Some forages, such as *Pennisetum purpureum* and hybrids, will only grow well on fertile soils.

Many of the forages recommended in this booklet will grow on infertile soils and some (such as *Brachiaria humidicola* and *Stylosanthes guianensis)* will grow even on very acid, infertile soils (see Table 2). However, no species will produce high yields on infertile soils unless manure or fertiliser is applied. On extremely infertile soils, forages may not contain enough nutrients for good animal growth.

Forages for very alkaline soils

Most forage species can grow in alkaline soils. Some are particularly suited to high-pH soils. These are *Leucaena*

leucocephala, Desmanthus virgatus and *Brachiaria humidicola.* One species which does not grow well on very alkaline soils is *Stylosanthes guianensis.*

Forages for waterlogged soils

Most forages will tolerate a few days of waterlogging but few can grow well in soils which are waterlogged for extended periods. Some forage species that can tolerate waterlogging better than others are *Brachiaria mutica, Paspalum atratum, Setaria sphacelata, Brachiaria humidicola, Macroptilium gracile and Codariocalyx gyroides.*

Forages for areas that are burnt regularly

Most forage grasses will tolerate burning as their

tolerate burning as their growing points are close to the ground (eg. *Brachiaria* species). Most forage legumes have all their growing points high above ground and are easily killed by fire (eg. *Stylosanthes guianensis, Centrosema pubescens).* However, these legumes often *regenerate* from seed after fire. One legume which can survive even severe fires is *Leucaena leucocephala*

More about each species ...

Table 3: Growth forms and life span of forages

S-Short-lived (1-3 years)
***L- Long-lived (more than 3 years)* V**
L- ***very long-Lived (more than 6 years)***

Grasses

Andropogon gayanus

Recommended variety:

'Gamba'

- **tall grass for cutting**
- **stays green in dry season**
- **grows well on infertile, acid soils**

  but

- **becomes stemmy if not cut frequently**

Gamba' has fluffy seed heads(WS)

'Gamba' is a tall perennial grass that is readily eaten by livestock when young. It has soft leaves with fine hairs and seed heads on very tall stems (up to 4m). The seed is light and fluffy.

It grows well on infertile, acid soils in hot climates. It will grow in a wide range of soils and climates but is particularly useful in

areas with a long dry season. 'Gamba' stays green long into the dry season when most other grasses are already dry.

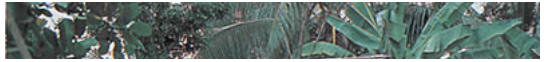
It is easy to cut but it can tolerate grazing. It needs frequent cutting or it produces seed heads which are stemmy and unpalatable.

'Gamba' can be easily planted from young rooted tillers but not old tillers. Establishment from seed is often difficult because of

poor seed quality.

'Gamba' is leafy when cut (WS)

It becomes stemmy if not cut frequently (JH)



In Makroman , Indonesia 'Gamba' is used for cut & carry feeding (WS)

Brachiaria brizantha

Recommended varieties:

'Marandu'
'Karanga'
'Serengeti'

- **tall grass suitable for cutting**

- **grows well on moderately fertile, acid soils**
- **stays green in the dry season**
- **better seed production than *B. decumbens***

  but

- **should not be fed to goats, sheep and young cattle**

'Marandu' for cut and carry near the house (WS)

***Brachiaria brizantha* is a perennial grass with a wide range of growth habits. All varieties are suitable for cutting and**

grazing. Of the three recommended varieties, 'Karanga' and 'Marandu' are tall, growing up to 2m. 'Serengeti' is a

shorter grass (up to 1m) similar in growth habit to *B. decumbens.* The three varieties produce good seed, except near the equator.

All three varieties are adapted to a wide range of climates and soils. They will grow and persist on infertile, acid soils, but they need slightly higher fertility than *B. decumbens and B. humidicola* for good growth. *B. brizantha* stays green long into the dry season.

'Marandu' stays green in the dry season while* Paspalum atratum *'Terenos' does not (WS)

B. brizantha should never be fed to sheep, goats or young cattle (see Special

young cattle (see Special Considerations).

'Marandu' is not well adapted to waterlogged soils and sometimes suffers from leaf disease in areas with very high rainfall. The other two varieties are more suited to such areas.

B. brizantha can easily be planted from rooted cuttings or seed.

B. brizantha *varieties produce good seed (JH)*

'Marandu' (JH)

Brachiaria decumbens

Recommended variety:

'Basilisk'

- **for grazing, sometimes used for cutting**
- **adapted to a wide range of soils**
- **stays green into the dry season**

but

- **should not be fed to goats or sheep**
- **poor seed production in Southeast Asia**

Grazed plots in North Sumatra, Indonesia (WS)

'Basilisk' is a vigorous perennial grass growing to 1m. If left uncut tillers fall over, grow sideways and provide good ground cover. Seed production is frequently poor in Southeast Asia.

It is adapted to a wide range of climates and soils, and will persist on infertile, acid soils. It is well suited to the wet/dry tropics, remaining green long into the dry season. 'Basilisk' is better suited to lower soil fertility and longer dry seasons than *Brachiaria brizantha.*

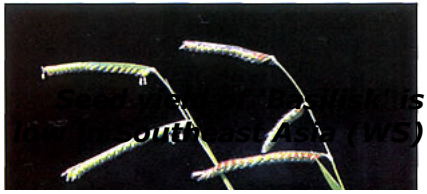
'Basilisk' should never be fed to sheep, goats or young cattle (see Section 3, Special Considerations).

It can be planted from rooted cuttings. Planting from seed can be unreliable because seed quality is often poor.

'Basilisk' (JH)

Note:

Brachiaria brizantha 'Serengeti' is a promising alternative to 'Basilisk'. It is similar in growth habit but, unlike 'Basilisk', produces high yields of good seed in many areas in Southeast Asia.



Seed of 'Basilisk' is for Southeast Asia (WS)

Brachiaria humidicola

Recommended varieties:

'Tully'

'Yanero'

- **vigorous creeping grass**
- **good for erosion control**
- **can tolerate heavy grazing**
- **can grow on very infertile soils**
- **can tolerate some waterlogging**

but

- **lower quality feed than other *Brachiaria* species**

B. humidicoia (here 'Yanero') tolerates heavy grazing (WS)

***Brachiaria humidicola* is**

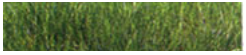
an aggressive, low

growing grass. It spreads quickly via stolons. 'Yanero' is more leafy than 'Tully ' but both varieties have a lower feed quality than other *Brachiaria* species. 'Tully' spreads more rapidly than 'Yanero' and is well suited to erosion control. Seed production is frequently poor in Southeast Asia.

Being low growing both varieties are less suitable for cut-and-carry than other *Brachiaria* species, but can tolerate heavy grazing.

B. humidicoia (here 'Yanero') spreads by stolons (WS)

They will grow in a wide range of soils from very infertile, acid



soils to high pH sandy soils. They grow best in the wet tropics with no or short dry season. They are tolerant of waterlogging and can survive short periods of flooding.

They should be grazed frequently during the wet season otherwise they produce a lot of stems which are unpalatable. Establishment from stolons is easy. Planting from seed is often difficult since it is slow to establish, even from good seed. Seed quality is frequently poor.

***B. humidicola* can be fed to sheep and goats in small quantities only.**

Feeding large quantities may cause

'Tully' is excellent for controlling soil erosion (WS)

'Tully' and 'Yanero' form a thick pasture (JH)

photosensitization (see Special Considerations).

Note: 'Yanero' was previously known as *Brachiaria dictyoneura* CIAT 6133.

Brachiaria ruziziensis

Recommended variety:

'Ruzi'

- **good seed production**
- **establishes easily from seed or cuttings**
- **provides high quality forage**

but

- **needs high soil fertility**
- **poor persistence on infertile soils**
- **not adapted to long**

- **not adapted to long dry seasons**

'Ruzi grows well in fertile soils (JH). It has hairy leaves (JH)

'Ruzi' is a leafy, medium height, stoloniferous grass which is used extensively in Thailand. It has short hairy leaves. In many areas it produces high seed yields. The seed quality and germination percentage are usually high.

It is adapted to well-drained, fertile soils in high rainfall areas. In these conditions it provides higher quality feed than other *Brachiaria* species . It is not well suited to infertile soils, poorly drained soils or areas with a long dry season.

'Ruzi' should never be fed to sheep , goats or young cattle (see Special Considerations).

It can easily be planted from seeds or stolons.

Seed production is high (WS)

'Ruzi' spreads by stolons (JH)

It does not grow weil in the dry season (JH)

Panicum maximum

Recommended variety:

'Si Muang'

- **tall grass suitable for cutting**
- **suited to more fertile soils**
- **produces high quality feed**

but

- **must be fertilised regularly**
- **becomes stemmy if not cut frequently**
- **not suited to long dry seasons**

'Si Muang' has purple stems (JH)

It is *a tall, upright grass (LS)*

'Si Muang' is a tall grass suitable for cutting which can also be lightly grazed. It produces high quality feed if grown in fertile

feed if grown in fertile soils. It has been selected by the Department of Livestock Development in Thailand because it is leafier and has broader adaptation than other varieties of *Panicum maximum.*

It is adapted to areas with a short or no dry season although it can survive in areas with long dry seasons. It needs high soil fertility; manure or fertiliser needs to be applied to maintain good growth. 'Si Muang' is best suited to well drained, fertile soils but will survive on moderately fertile soils. It does not tolerate waterlogging.

'Si Muang' used for cut and carry in northern Laos (JH)

'Si Muang' is known for its fast regrowth after cutting. It must be cut frequently, otherwise it quickly produces hard, unpalatable flowering

unpalatable flowering stems.

It can easily be established from rooted cuttings or seed. Seed yield of 'Si Muang' is high in many areas and seed quality is better than earlier *P. maximum* varieties.

Note:

Another promising variety, 'Tobiata', is taller and has

broader leaves than 'Si Muang'. 'Tobiata ' has hard hairs on the base of stems which can irritate skin during cutting.

It produces good seed throughout Southeast Asia (JH)

Paspalum atratum

Recommended variety:

'Terenos'

- **tall grass for cutting**
- **grows well on infertile, acid soil**
- **wet tropics with short or no dry season**
- **can tolerate some waterlogging**
- **very leafy**

but

- **not suited to long dry seasons**

'Terenos' grown along a fence in Indonesia (WS)

Terenos' is a tall bunch grass with broad leaves. It is very leafy and palatable when growing in good conditions.

'Terenos' can become coarse and unpalatable during dry periods. It produces large quantities of seed in most areas except those close to the equator.

It is a good choice for moderately fertile and infertile soils in the wet tropics. It is particularly useful for soils that are occasionally waterlogged. 'Terenos' can survive in areas with a long dry season but will not grow well. It grows well in cooler areas (eg. high elevation) where it tolerates some dry periods.

Farmers often like 'Terenos' because it is easy to cut and has fast regrowth. It can also be grazed.

It can be planted from seed, but is also easily propagated using rooted tillers.

Terenos' ***is easy to cut (MH)***

It produces good seed (WS)

Regrowth of P. atratum is very fast (WS)

Pennisetum purpureum and hybrids

Recommended varieties:

'Napier'

(local varieties of *P. purpureum)*

'Mott'

***(P. purpureum* cv. Mott)**

'King

***(P. purpureum* x *P. glaucum* hybrid)**

- **very tall grasses for cut & carry**
- **highest yielding species with high soil fertility and irrigation**
- **high quality feed**

but

- **will not persist without fertilising**
- **not suited to long dry seasons**
- **becomes stemmy if not cut frequently**

'King' grass in the early dry season in Indonesia (JH)

'Napier' grass for cut & carry in Thailand (JH)

***Pennisetum purpureum* and the hybrid *(P. purpureum* x *P. glaucum)* are very tall grasses which are well**

grasses which are well suited to cutting. 'King ' is taller, leafier and more productive than 'Napier' or 'Mott' in soils of high fertility, but is less robust and persistent under declining fertility or during dry periods.

'Mott ' (sometimes called 'dwarf napier') has many more tillers and is leafier than 'Napier'. 'Mott' is better suited to planting in hedgerows than other *Pennisetum* varieties, although all *Pennisetum* varieties need a lot of nutrients and tend to compete with nearby crops.

Pennisetum *varieties can be leafy when cut often (JH)*

Pennisetum species are potentially the most productive grasses available, but do not

tolerate low fertility or dry conditions. They are best suited to fertile soils in areas with high rainfall and only a short dry season.

Fertiliser or manure must be added regularly to maintain productivity. Many farmers grow these species close to the animal shed to make it easier to apply manure.

Using 'King' grass as a fence around a chicken pen in Indonesia (WS)

They must be cut frequently to remain leafy. If the plants are allowed to grow tall, they produce a lot of unpalatable stem.

They can easily be planted from stem cuttings.

They have very

Pennisetum

high yields but get very stemmy if not cut frequently (JH)

varieties need manure or fertiliser for good growth (JH)

Setaria sphacelata

Recommended varieties:

'Lampung'

(S. sphacelata* var. *splendida)

'Solander'

(cv. Solander)

- **erect grass for cutting**
- **soft and palatable leaves**
- **can survive in poor soils**
- **can tolerate waterlogging for short periods**
- **grows well in cool areas**

but

- **needs good moisture and soil fertility for high production**
- **some leaf disease in the humid tropics**
- **should not be fed to horses**

'Splendida' used for hedgerows in the Philippines (WS)

Setaria sphacelate **is an erect, perennial grass of medium**

height. It has soft, palatable leaves and young stems. It can be recognized by the grey-green colour of its leaves. It is suitable for cutting, although it can be lightly grazed.

'Lampung' does not produce seed and has to be propagated vegetatively. 'Lampung' is best suited to the wet tropics with a short dry season. Leaf diseases can occur in very wet conditions.

'Solander' produces seed and is better suited to cooler conditions (eg. high elevations) than 'Lampung'. Although both varieties will survive in infertile soils, they need moderately fertile soils for good growth. They are able to withstand several days of waterlogging.

'Splendida' is easy to cut (WS)

Setaria should not be fed to horses (see Special Considerations).

Both varieties are easily propagated by rooted tillers.

Note:

'Kazungula' (*S. sphacelate* cv. Kazungula in Australia) is another variety of this species which can sometimes be found in Southeast Asia. It is lower growing than 'Lampung' or 'Solander' and is more suited to grazing. 'Splenda' (*S. sphacelata* cv. Splenda in Australia) is a seed-producing variety similar to 'Lampung'.

'Solander' produces seed while 'Splendida' does not (JH)

Setaria varieties have a flattened stem at the base and blue-green leaves (JH)

More about each species ... Legumes

Arachis pintoi

Recommended varieties:

'Amarillo'
'Itacambira'

- **low growing stoloniferous legume**
- **very persistent especially under heavy grazing**
- **good ground cover under trees**
- **high quality animal feed**
- **establishes easily from cuttings**

but

- **needs moderately fertile soils**
- **not suited to long dry seasons**

Arachis pintoi *spreads quickly through stolons and sets seeds below ground (PH)*

Arachis pintoi is a vigorous stoloniferous legume that forms a dense green carpet usually with a mass of yellow flowers. It is a high- quality feed for all animals including chickens, ducks and pigs. It can withstand heavy grazing or cutting. It is an excellent ground cover for weed control under trees and erosion control on slopes.

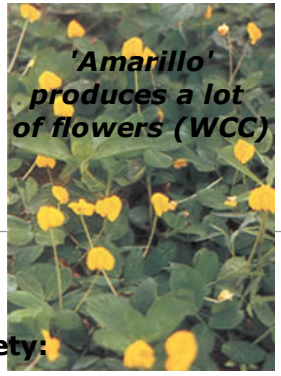
There are many useful varieties of *A. pintoi.* Of these, 'Itacambira' and 'Amarillo' are the most widely used in Southeast Asia.

A. pintoi needs moderately fertile soils. It is best suited to the wet tropics with short or no dry season. It is not suited to areas with a long dry season except in cooler areas. It grows well in light to moderate shade under trees.

Unlike other legumes, *A. pintoi* needs to be cut or grazed frequently to improve its yield and persistence.

It can be easily established from stolons and rooted cuttings. A special feature of this legume is that it is a peanut and produces seed under ground which makes harvesting of seed difficult. Seed quality falls quickly during storage. Establishment from seed is easy, provided good seed is available.

All* A. pintoi *varieties are good ground covers under trees (WS)



'Amarillo' produces a lot of flowers (WCC)

Arachis pintoi *(here 'Itacambira') varieties form dense swards (JH)*

Calliandra calothyrsus

Recommended variety:

'Besakih'

- **good tree legume for cooler areas**
- **can grow in acid soils high leaf yield**

  under cutting
- **good fire wood**

but

- **palatable only when fresh**
- **needs to be planted from seed**
- **slow seedling growth**

'Besakih' grows well in cooler areas (AP)

Calliandra calothyrsus is a long-lived small tree which is very productive under regular cutting. Unlike many other legumes, it is usually free of pests and diseases. It has distinctive red flowers.

'Besakih' is particularly adapted to cooler areas (eg. high elevation) and wet areas with a short or no dry season. It grows in a wide range of soils, including acid soils, but needs moderate fertility. Once established, it survives dry periods, particularly on deep soils.

It is often grown as hedgerows. Sheep and goats eat it readily but cattle sometimes require a short period to get used to it. A special feature of *C.*

calothyrsus is that it has to be fed fresh, since wilted leaves are not

palatable. 'Besakih' is successfully used for fattening cattle at altitudes above 500m in Bali.

It must be planted from seed. As with all tree legumes, seedling establishment is slow. For successful establishment seedlings must be protected from grazing animals, weeds and fire. Seed production may be poor in areas where there are no bats since these are known to be efficient

pollinators of *Calliandra* flowers.

It has distincitive square young stems (WS)

Calliandra calothyrsus

produces good quality fire wood (AP)

It has a distinctive red flower (AP)

Centrosema pubescens; C. macrocarpum

Recommended varieties:

'Barinas' *(C. pubescens)*

'Ucayali' (C. *macrocarpum)*

- **twining legumes**

- **good for weed control**
- **grow well with tall grasses for cut-and-carry**

but

- **not adapted to long dry seasons**
- **need moderately fertile, well-drained soils**
- **need to be planted from seed**

'Barinas' used as a cover crop in maize (shortly after harvest)

in Indonesia (JH)

'Barinas' and 'Ucayali' are vigorous twining legumes. They are a high- quality feed for animals. They are better suited to cutting than grazing. They can be used as cover crops to suppress weeds in crop fallows and annual crops. They can also be grown together with tall grasses for cut *&.* carry feed.

'Ucayali' has bigger leaves than 'Barinas' and grows better in drier conditions. The white-flowering 'Barinas' is more vigorous than other varieties of *C. pubescens.* It produces roots from nodes, making it more persistent

making it more persistent.

Both varieties need moderately fertile, well-drained soils for good growth. They grow best in the wet tropics with a short dry season. They do not tolerate waterlogging.

They cannot withstand heavy cutting or grazing. They grow best if left to regrow for long periods after cutting (more than 6 weeks) and if cut leniently (not close to the ground).

Both 'Barinas' and 'Ucayali' have to be grown from seed. They flower and produce seed early in the dry season. Seed production is only good if they are grown on trellises (eg. on fence lines). Seed yields are highest in areas with a distinct dry season.

All *Centrosema* species are susceptible to rhizoctonia leaf disease during wet periods, but 'Barinas' and 'Ucayali' recover well.

Both *species (here 'Barinas') have large seeds and are easy to plant (JH)*

Centrosema macrocarpum ' *Ucayali ' has larger leaves than* C. pubescens *'Barinas' (JH)*

'Barinas' has white and pink flowers (JH)

'Barinas' produces roots at nodes which make it more persistent than common Centra (WS)

Desmanthus virgatus

Recommended variety:

'Chaland'

- **shrubby legume for cutting**
- **grows best on fertile clay soil**
- **high-quality feed**
- **used for leaf meal production**
- **easy seed production**

but

- **not suited to acid soils**
- **needs to be planted from seed**

'Chaland' is leafy (JH)

'Chaland' is an erect bushy legume growing to 2m which is used in Thailand. Individual plants usually persist for 3-5 years. The leaves are a high-quality feed that can be fed fresh or dried for leaf meal. It can be grown in hedgerows.

It is especially suited to fertile clay soils with neutral to high pH. Although it can survive in areas with a long dry season, it grows

best in the wet tropics in areas with only a short dry season.

It has to be grown from seed. Seed production is easy in most areas where it is grown. The seed has a hard coat which prevents germination unless it is scarified (refer to the booklet 'Developing forage technologies with smallholder farmers - how to grow, manage and use forages').

Leaves of 'Chaland' are susceptible to damage by psyllid insect but plants recover well.

It is a shrubby legume (JH)

Seed production is easy (JH)

Desmodium cinerea

Recommended variety:

'Las Delicias'

This species used to be called *Desmodium rensonii.*

- **fast-growing shrub for cutting**
- **suited for hedgerows**
- **good quality feed**
- **best in wet tropics**

but

- **short-lived (up to 2-3 years)**
- **needs to be planted from seed**

'Las Delicias' grown as hedgerows in Indonesia (WS)

'Las Delicias' is a short-lived (2-3 years) shrub growing to 3 m. It has fast seedling growth which makes it easier to establish than other

shrub legumes. Stems become woody and have few branches. It produces a lot of leaf under regular cutting.

It is best adapted to

moderately fertile, neutral or slightly acid soils. It grows best in the wet tropics with a short or no dry season and is not suited to areas with a long dry season.

It has distinctive round leaves (JH)

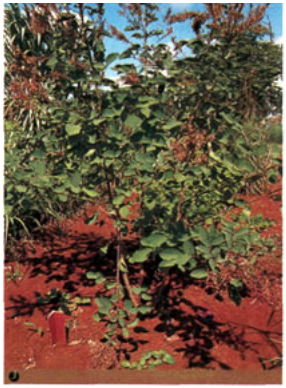
The use of 'Las Delicias' in hedgerows has been promoted widely by the Mindanao Baptist Rural Life Center in the Philippines.

It is a high-quality feed supplement which is readily eaten by most animals.It has to be planted from seed. Seed

planted from seed. Seed production is high in most areas where it is adapted.

Note:

A related species is *Codariocalyx gyroides*.



It produces a lot of seed in most areas of Southeast Asia (JH)

Gliricidia sepium

Recommended varieties:

'Retalhuleu'
'Belen Rivas'

- **easy to plant from stem cuttings**
- **useful as a living fence**
- **grows in moderately acid soils**

- **good dry season feed supplement**

but

- **low palatability for cattle**
- **susceptible to pests**


Gliricidia sepium *is ideally suited for living fences (PH)*

Gliricidia sepium is *a* medium-sized tree which produces a high leaf yield under frequent cutting. It has pink flowers which distinguishes it from the white flowering *G. maculata.* 'Retalhuleu' and 'Belen Rivas' are more productive and leafy than other varieties of *G. sepium.*

G. sepium Is one of the few tree legumes that can be propagated easily from stem cuttings. This makes it particularly suited to living fences.

It grows best in wet

It grows best in wet tropical areas with short to moderate dry seasons. It can grow on acid soils but requires moderate fertility. It will not grow in very acid soils or in cool areas (eg. elevations > 800m). It does not tolerate long periods of waterlogging.

The leaves of *G. sepium* are a high-quality feed supplement that are readily eaten by sheep and goats. Cattle and buffalo often need to be trained to eat it but, once used to its smell, will eat it readily. Mixing leaves of *G. sepium* with other forages is a good way to train animals to eat it. It is successfully used for fattening of cattle in Bali.

'Sheep like eating* G. sepium *(WS)

During the dry season it normally drops its leaves. If cut late in the wet season, it produces new leaves which stay on the trees until late in the dry season.

Gliricidia sepium *has distinctive pink flowers (WS)*

There are only a few areas in Southeast Asia where *G. sepium* produces seed. These are areas with a distinct dry season, such as eastern Indonesia. This is not a major problem

since it is easily propagated from stem cuttings. Planting from cuttings may give a shallower root system than planting from seed, making the trees less productive in dry conditions.

In humid areas it can

be susceptible to insect pests.

Gliricidia maculata *has white flowers (PH)*

'Retalhuleu' produces high leaf yields (WS)

Leucaena leucocephala

Recommended varieties:

'K 636'
'K 584'

- **highly productive**
- **tolerant of heavy cutting and grazing**
- **high-quality feed supplement**
- **good fire wood**
- **good dry season growth**

but

- **not for acid, infertile soils**
- **not for monogastric animals**
- **susceptible to psyllid insects**
- **needs to be planted from seed**

Leucaena leucocephala *is often grown with other crops (PH)*

Leucaena leucocephala **is a long-lived tree that is highly productive under regular cutting. Once established it is extremely tolerant of cutting, and can also be grazed. The leaves can be used as a high-quality feed supplement, especially in the dry season. It produces good-quality firewood.**

'K636' and 'K584' are the most productive *L*

***leucocephala* 'K636' tends to have a single tall main stem, but produces more branches when cut frequently. 'K584 ' has more branches than 'K636'. *L leucocephala* is well adapted to wet tropical areas with a distinct dry season. It grows best on heavy fertile soils with neutral or high pH. It does not tolerate infertile, acid soils or soils prone to waterlogging. It is not well suited to cool conditions.**

It is usually planted from seed (JH)

It can be grown as intensive backyard plots, hedgerows or living fences. It must be planted from seed. Seed production is usually easy. The seed has a hard coat which

hard coat which prevents germination unless it is scarified (refer to the booklet 'Developing forage technologies with smallholder farmers - how to grow, manage and use forages').

As with all tree legumes, seedling establishment is slow and seedlings must be protected from grazing animals, weeds and fire.

All *L leucocephala* varieties are susceptible to damage by psyllid insects. 'K636' and 'K584' are more tolerant of psyllids than other varieties (eg. cv. Cunningham).

L. leucocephala should not be fed to monogastric animals in large amounts (see Special Considerations).

Note: In the future, Fl hybrids between 'K636' or 'K584' and other *Leucaena* species may become available. These are likely to be more productive than 'K636' and 'K584' in areas with high psyllid attack.

It 75 protein-rich feed (JH)

L. leucocephala is *hardseeded and needs to be scarified before sowing (JH)*

It produces good firewood (PH)

Stylosanthes guianensis

Recommended variety:

Recommended variety: 'Stylo 184'

- **erect, robust legume for cutting**
- **highly productive**
- **good quality feed**

- **many uses including leaf meal production**
- **widely adapted to low fertility and acid soils**
- **leaf stays green into the dry season**
- **resistant to the fungal disease anthracnose**

but

- **short-lived (2-3 years)**
- **not tolerant of heavy grazing or frequent cutting**

Stylo 184 grown as a fallow crop and fed sheep in Indonesia (WS)

'Stylo 184' is a short-lived perennial legume

(2-3 years) that grows into a small shrub with some woody stems.

It is adapted to a wide range of soils and climates but is one of the few herbaceous legumes which will grow well on infertile, acid soils. It will not grow on very alkaline soils (pH >8). Unlike earlier varieties of 5.

guianensis **(eg. cv. Schof ield, Cook and Graham) 'Stylo 184' has shown good resistance to the fungal disease anthracnose in Southeast Asia .**

It produces seed in most areas in Southeast Asia (EO)

It is usually grown as a cover crop which is cut every 2-3 months. It effectively suppresses weeds and is a good feed supplement for animals including chickens, pigs and fish. 'Stylo 184' can

and fish. 'Stylo 184' can be fed fresh or dried for hay and processed into

leaf meal.

It does not tolerate being cut close to the ground since there are few buds on the lower stem for regrowth. This can be improved by making the first cut at 10-20 cm to encourage branching close to the ground. Subsequent cuts must be made higher (>25 cm) to ensure good regrowth.

It is usually planted from seed, although some farmers are using stem

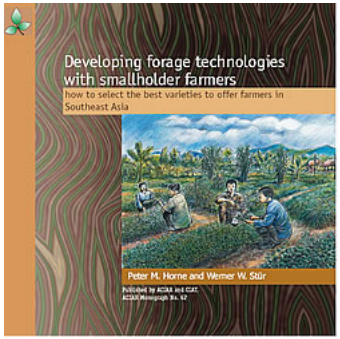
cuttings. Seed production is possible in most areas but is best in areas with a distinct dry season.

Note: It is possible that 'Stylo 184' may one day become susceptible to

It can be easily recognised by its leaf shop and yellow flower (WS)

anthracnose. New varieties of 5. *guianensis* are being evaluated in Hainan , China for better resistance to this disease.

Stylo 184 is a protein-rich feed (JH)



Other potentially useful forages

The following potentially useful forage species are only for special situations, or have yet to be proven in smallholder farming systems:

Grasses

Brachiaria mutka 'Para'

It is common throughout the region in poorly drained and flooded soils. In Thailand it is grown for dairy cattle in paddy fields which were previously growing lowland rice. It is not suited for drier conditions.

Digitaria milanjrana 'Jarra'

It is a low-growing, stoloniferous, perennial grass with soft leaves. It is best suited to areas with a short dry season. Its adaptation is similar to that of *Brachiaria decumbens* and is of particular interest because it can be fed to sheep, goats and young cattle.

Paspalum guenoarum 'Bela Vista'

It is very similar to P. atratum. It is less productive, but has softer leaves and is very palatable. It is not suited to very high rainfall areas where it is

susceptible to leaf spot fungus.

Stenotaphrum secundatum 'Vanuatu'

It is a strongly stoloniferous grass suitable for grazed plots in moderate shade. Smallholder farmers in Vanuatu use it extensively in grazed pastures under coconuts. It is adapted to the humid tropics with no or only a short dry season, and grows best in soils with high organic matter. Its feeding value is slightly lower than that of *B. humid/cola.* Vanuatu' produces no viable seed but is easily propagated by stolons. Here grown with 'Amarillo'.

Legumes

Centrosema pascuorum 'Cavalcade'

It is an annual, twining legume which may be used as a cover crop or fallow species. Its adaptation is similar to that of *Macroptilium gracile* (see below). In Thailand it is used for making hay.

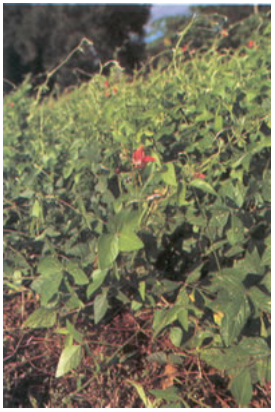
Codariocalyx gyroides 'Belize'

It is a short-lived (3-4 years), small woody shrub which is very similar to *besmodium cinerea* (previously *b. rensonii).* 'Belize' grows best in the wet tropics and can tolerate waterlogging.

Flemingia macrophylla 'Chumphon'

It is a long-lived, large woody shrub. 'Chumphon' is the most leafy and productive variety available. F. *macrophylla* is one of the very few shrub legumes which will grow well on very infertile, acid soils. It is best suited to the wet tropics. Leaves are not readily eaten by animals, since they contain high levels of tannins. (Soats will eat leaves of *F. macrophylla* if they are mixed with other feed. Cut branches are useful for improving soil fertility, since leaves break down slowly in the soil.

Macroptilium gradle 'Maldonado'

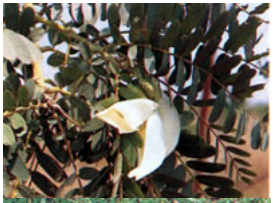


'Maldonado' is a short-lived (1-2 years), twining legume that is particularly vigorous for the first few months after sowing. It is an excellent short-term cover crop and can be used for grazing in mixtures with grasses. 'Maldonado' can be grown in a wide range of soils, including infertile and sandy soils. *A* special feature is that it survives waterlogging and short-term flooding.

Sesbania grandiflora 'Turi'

It is a fast growing, short-lived (3-5 years), single-stemmed tree. It is a high-quality feed supplement, especially for the dry season, but leaf yields are low. It is well adapted to areas with a long dry season

but needs moderate soil fertility. 'Turi' dies if the main stem is cut but side branches can be trimmed regularly. Local varieties are available in many parts of Southeast Asia.



Stylosanthes hamata 'Verano'

A very hardy short-lived (1-2 years) legume for heavily grazed plots in areas with a long dry season. In northeast Thailand it has been oversown along roadsides and vacant areas.

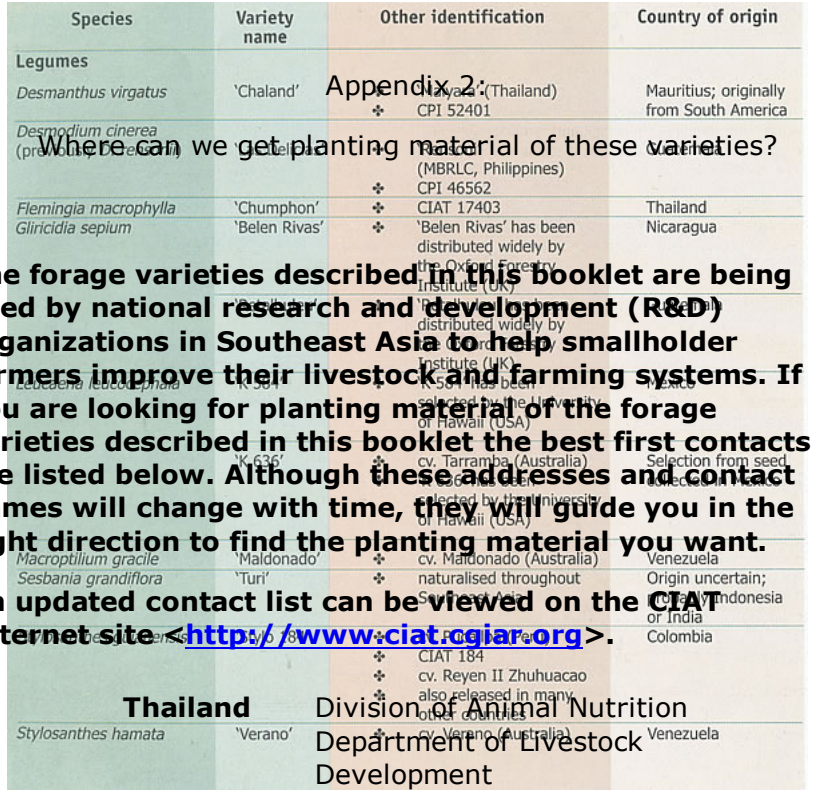
- More about each species ...
  - Grasses
  - **Legumes**
  - **Other potentially useful forages**
- Appendices
  - **Origin and identification of recommended forage varieties**
  - **Where can we get planting material of these varieties?**

Appendix 1:

Origin and identification of recommended forage varieties.

Species	Variety name	Other identification	Country of origin
Grasses			
Andropogon gayanus	'Gamba'	✣ cv. Kent (Australia) ✣ CIAT 621 ✣ also released in many other countries	Nigeria
Brachiaria brizantha	'Karanga'	✣ CIAT 16835	Zimbabwe
	'Serengeti'	✣ CIAT 6387	Kenya
	'Marandu'	✣ cv. Marandu (Brazil) ✣ CIAT 6780, ILCA 16550 ✣ also released in many other countries	Zimbabwe
Brachiaria decumbens	'Basilisk'	✣ cv. Basilisk (Australia) ✣ CIAT 606 ✣ also released in many other countries	Uganda
Brachiaria humidicola	'Yanero'	✣ cv. Llanero (Colombia) ✣ CIAT 6133 ✣ also released in many other countries	Zimbabwe
Brachiaria humidicola	'Tully'	✣ cv. Tully (Australia) ✣ CIAT 679 ✣ also released in many other countries	Origin uncertain; introduced to Australia from South Africa
Brachiaria mutica	'Para'	✣ naturalised throughout Southeast Asia	Origin uncertain; probably tropical Africa
Brachiaria ruziziensis	'Ruzi'	✣ cv. Kennedy (Australia)	Rwanda
Digitaria milanjiana	'Jarra'	✣ cv. Jarra (Australia)	Malawi
Panicum maximum	'Tobiata'	✣ cv. Tobiata (Brazil) ✣ CIAT 6299	Kenya
	'Si Muang'	✣ T-58 'Purple Guinea' (Thailand) ✣ cv. Tanzania 1 (Brazil) ✣ CIAT 16031, ILCA 16554	Ivory Coast

Species	Variety name	Other identification	Country of origin
Grasses			
Paspalum atratum	'Terenos'	✣ BRA 9610, CIAT 26986 ✣ cv. Hi Gane (Australia) ✣ cv. Suerte (USA)	Brazil
Paspalum guenoarum	'Bela Vista'	✣ BRA 3824, CIAT 26985	Brazil
Pennisetum purpureum	'Napier'	✣ many local varieties	Tropical Africa
	'Mott'	✣ cv. Mott (USA)	Bred variety; parent lines originally from tropical Africa
P. purpureum x *P. glaucum* hybrid	'King'	✣ King grass (Indonesia) ✣ many similar hybrids available (eg. Florida napier in the Philippines)	Bred variety; parent lines originally from tropical Africa
Setaria sphacelata	'Solander'	✣ cv. Solander (Australia)	Bred variety; parent lines originally from tropical Africa
S. sphacelata var. *splendida*	'Lampung'	✣ 'Splendida' (Indonesia) ✣ CPI 15899	Sterile hybrid; Tropical Africa
Stenotaphrum secundatum	'Vanuatu'	✣ naturalised in Vanuatu	Southern Africa
Legumes			
Arachis pintoi	'Itacambira'	✣ CIAT 22160	Brazil
	'Amarillo'	✣ cv. Amarillo (Australia) ✣ CIAT 17434 ✣ also released in many other countries	Brazil
Calliandra calothyrsus	'Besakih'	✣ naturalised in Indonesia ✣ CPI 115690	Central America; possibly Guatemala
Centrosema macrocarpum	'Ucayali'	✣ CIAT 25522 ✣ cv. Ucayali (Peru)	Composite of several lines from Brazil, Colombia and Venezuela
Centrosema pascuorum	'Cavalcade'	✣ cv. Cavalcade (Australia)	Bred variety; parent lines originally from Brazil
Centrosema pubescens	'Barinas'	✣ CIAT 15160	Venezuela
Codariocalyx gyroides	'Belize'	✣ CIAT 3001; ILCA 14924	Donated by Belize



Species	Variety name		Other identification	Country of origin
Legumes				
Desmanthus virgatus	'Chaland'	✣	cv. Chaland (Thailand)	Mauritius; originally from South America
		✣	CPI 52401	
Desmodium cinerea (previously *D. heterocarpon*)	'Pell'	✣	cv. Pell (MBRLC, Philippines)	Unknown
		✣	CPI 46562	
Flemingia macrophylla	'Chumphon'	✣	CIAT 17403	Thailand
Gliricidia sepium	'Belen Rivas'	✣	'Belen Rivas' has been distributed widely by the Oxford Forestry Institute (UK)	Nicaragua
	'Retalhuleu'	✣	'Retalhuleu' has been distributed widely by the Oxford Forestry Institute (UK)	Guatemala
Leucaena leucocephala	'K 500'	✣	'K 500' has been selected by the University of Hawaii (USA)	Mexico
	'K 636'	✣	cv. Tarramba (Australia)	Selection from seed collected in Mexico
	'K 8'	✣	'K 8' has been selected by the University of Hawaii (USA)	
Macroptilium gracile	'Maldonado'	✣	cv. Maldonado (Australia)	Venezuela
Sesbania grandiflora	'Turi'	✣	naturalised throughout Southeast Asia	Origin uncertain; Indonesia or India
Stylosanthes guianensis	'CIAT 184'	✣	CIAT 184	Colombia
		✣	cv. Reyen II Zhuhuacao	
		✣	also released in many other countries	
Stylosanthes hamata	'Verano'	✣	cv. Verano (Australia)	Venezuela

Appendix 2:

Where can we get planting material of these varieties?

The forage varieties described in this booklet are being used by national research and development (R&D) organizations in Southeast Asia to help smallholder farmers improve their livestock and farming systems. If you are looking for planting material of the forage varieties described in this booklet the best first contacts are listed below. Although these addresses and contact names will change with time, they will guide you in the right direction to find the planting material you want.

An updated contact list can be viewed on the CIAT Internet site <http://www.ciat.cgiar.org>.

Thailand

Division of Animal Nutrition
Department of Livestock Development
Phya Thai Road
Bangkok 10400
Thailand
Tel: (66 2) 251 1941
Current contact: Chaisang

Phaikaew

Pakchong Animal Nutrition Research Center
Pakchong
Nakornratchasima
30130
Thailand
Tel: (6644)311612
Current contact: Ganda Nakamanee

Philippines

Livestock Research Division
PCARRD
P.O. Box 425
4030 Los Banos, Laguna
Philippines
Tel: (63 49) 536 0014
Current contact: Ed Magboo

FARMI,
Visayas State College of Agriculture
6521-A Baybay,
Leyte
Tel: (63 53) 536 2433

Current contact: Edwin Balbarino

Indonesia

Bina Produksi
Direktorat Jenderal Peterftakan
Departmen Pertanian
Jalan Harsono, Rm. No. 3
Jakarta Selatan 12550, Indonesia
Tel: (6221)7815686
Current contact: Maimuftali Tuhulele

Balai Pengkajian Teknotogi Pertanian
BPTP Gedong Johor
Jalan Karyayasa No. IB
Medan, North Sumatra 20143
Tel: (62 61) 787 0710
Current contact: Tatang Ibrahim

Dinas Peternakan TK. 1 Kaltim
Jalan Bhayangkara No.

	54, Samarinda, East Kalimantan 75121 Indonesia Tel: (62541)43921 Current contact: Ibrahim
Vietnam	**National Institute of Animal Husbandry Ministry of Agriculture and Rural Development Thuy Phuong, Tu Liem Hanoi Tel: (84 4) 834 4775 Current contact: Le Hoa Binh**
	Tay Nguyen University Highway No. 14, Km 4 Buon Ma Thuot, Daklak Tel: (84 50) 853 781 Current contact: Truong Tan Khanh
	College of Agriculture & Forestry Thu Due Ho Chi Minh City Tel: (84 8) 896 3353 Current contact: Bui

	Xuan An
	Hue University of Agriculture & Forestry Centre for Rural Development in Central Vietnam 24 Phung Hung St. Hue Tel: (84 54) 525 049 Current contact: Le Van An
Lao PDR	**Nam Suang Livestock Research and Development Centre, National Agriculture and Forestry Research Institute Ministry of Agriculture and Forestry Vientiane Tel: (856 21) 222 796 Current contacts: Viengsavanh Phimphachanhvongsod, Phonepaseuth Phengsavanh**

China	**Tropical Pasture Research Center CATAS Danzhou 571737 Hainan Tel: (86 890) 330 0440 Current contact: Liu Guodao**
Malaysia	**Livestock Research Centre MARDI G.P.O. Box 12301 50774 Kuala Lumpur Tel: (603)9437335 Current contact: Wong Choi Chee**
For general enquiries:	**CIAT Regional Office c/o IRRI Makati Central P.O. Box 3127 1271 Makati City Philippines Tel: (63 2) 845 0563**