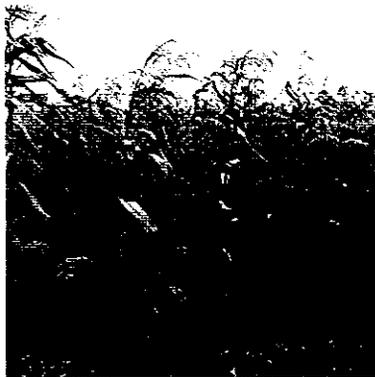
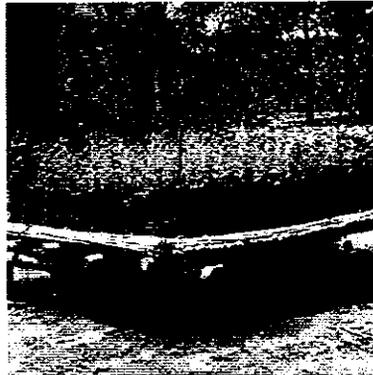


# MAFE Booklet Series No. 1: <sup>PN. ACS-049</sup> **Best-Bet Agroforestry and** <sup>118882</sup> **Soil Conservation Practices** (2001 EDITION)



## **MALAWI AGROFORESTRY EXTENSION PROJECT**

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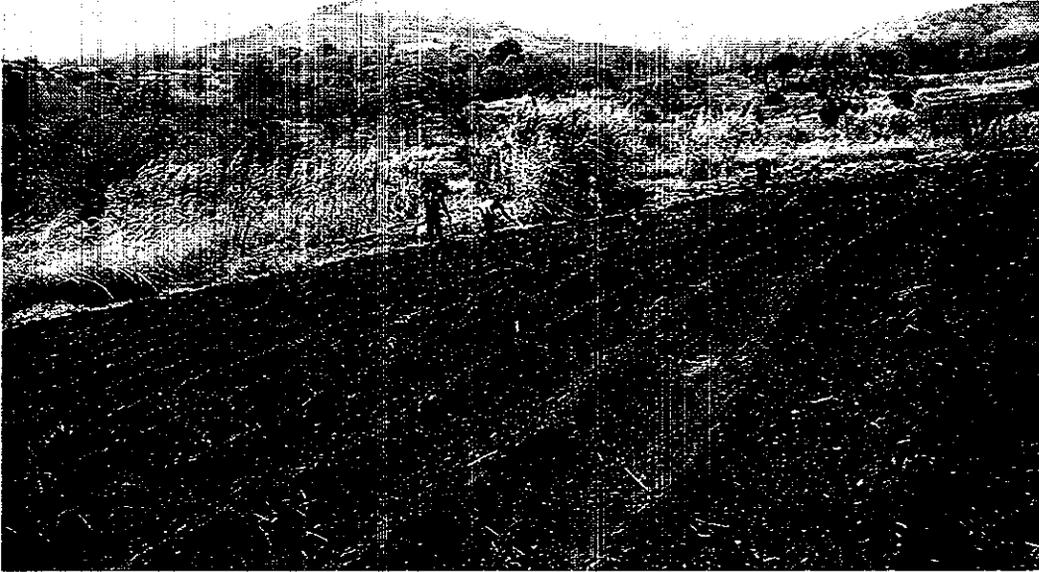
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## CHAPTER 1: CONTOUR RIDGING USING THE LINE LEVEL



*Ridges aligned with the contour*

### **Contour ridge your farm to:**

- ➔ **reduce water run-off and soil erosion**
- ➔ **conserve soil moisture for plant growth**
- ➔ **improve crop yields**
- ➔ **increase ground water supplies**
- ➔ **reduce siltation and flooding**

**Introduction:** Annual ridging by hand-hoe is the common method of land preparation in Malawi. Since few farmers cultivate on contour, ridges tend to channel water, which aggravates runoff and erosion. Contour ridging reduces these problems. To do this, contour marker ridges are built as guides to re-align planting ridges. Marker ridges may be constructed any time in the dry season after harvest. Planting ridges are then re-aligned when preparing land for next season's crop.

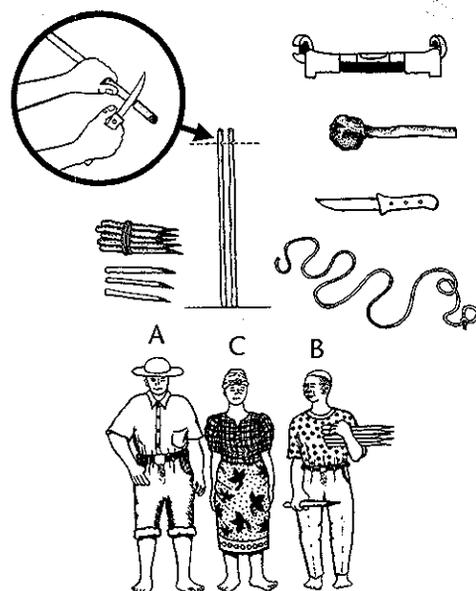
### Constructing marker ridges with a line level:

A line (spirit) level is a simple instrument for marking contour marker ridges. It consists of a spirit level that hangs from a taut string between two poles.

**Materials Required:** line level, 5 m string, 2 straight poles or sticks 1.6-2 m long with flat ends, panga, pegs, hammer/stone for driving in pegs, and 3 people (**Fig. 1**).

### Equipment Set Up and Testing:

1. Trim the ends of the sticks to make them flat. Then stand them upright on level ground, preferably the floor of a building. Cut a groove around each stick at exactly the same height above the ground (about 1.2 to 1.6 m or chest-level to make reading easy).
2. Tie 2 knots in the centre of the string, and hang the level between them to stop it from sliding.
3. Tie the string ends in the groove of each stick.



**Figure 1:** Equipment and people needed to mark contour lines with a line level. Note that making the grooves on the 2 sticks at exactly the same height is critical.

4. Two people set the sticks on a level surface (e.g., floor) with the string tight. Mark the exact positions of the 2 sticks on the floor. Then read the line level. Switch the positions of the sticks and read the level again.
5. If the bubble is not perfectly centred both times, check that (a) the floor is level, (b) the groove heights of both sticks are identical, and (c) the level is hanging properly. Correct any problems as needed.
6. If the checks above are correct, the line level must be faulty and needs to be replaced.

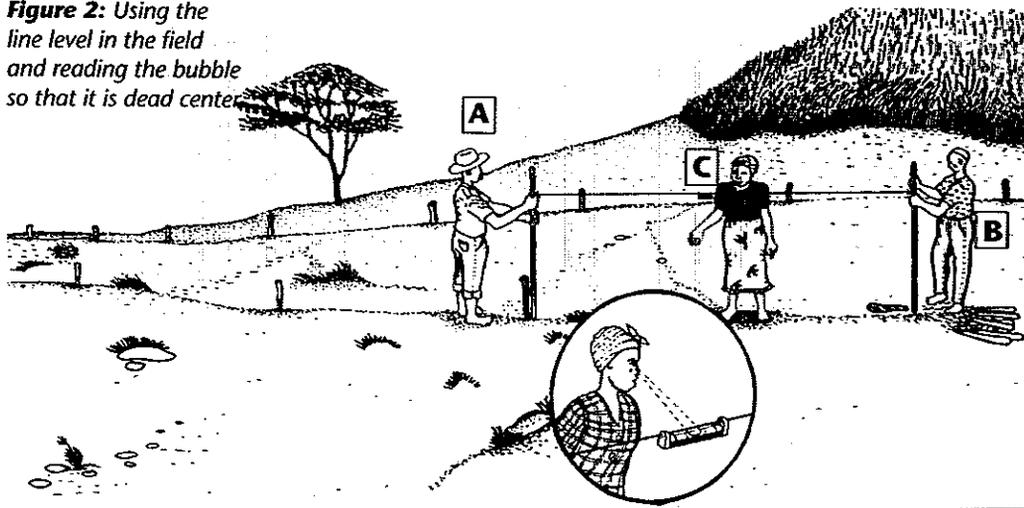


## Using the level in the field (see Fig. 2):

1. Start pegging at the top of the field about 10-20m below the upper corner.
2. Insert a peg to locate the starting point of A's stick. Avoid placing the sticks on rocks, ridges and anthills, or in holes and depressions.
3. C instructs B to move 5 m along the estimated contour line with the string tight.
4. C reads the position of the bubble. He/she instructs B to move up or down the slope until the bubble is precisely centred. Insert another peg at the precise location of B's stick.
5. Leaving B in place, A moves past B to locate the next peg. C instructs A to move up or down the slope while reading the line level.
6. Follow Step 4. When the bubble is perfectly centred, insert another peg at A's position.
7. Repeat the above steps, inserting pegs at each point till the end of the field is reached.
8. The team then moves downslope from the first contour line. The interval depends on the slope of the field, i.e. 20m apart for gentle slopes, 15m apart for medium slopes and 10m apart for steep slopes. Pegging of contour lines should cover the whole field.

**NOTE:** When pegging across paths, gullies, anthills, streams and the like, **shorten the string** to half its length (about 2.5m) to decrease the pegging interval for greater accuracy.

**Figure 2:** Using the line level in the field and reading the bubble so that it is dead center



**Smoothing Contour Lines:** Pegged contour lines may be smoothed out to reduce sharp angles between pegs. This simplifies the construction of marker ridges and re-alignment of planting ridges.

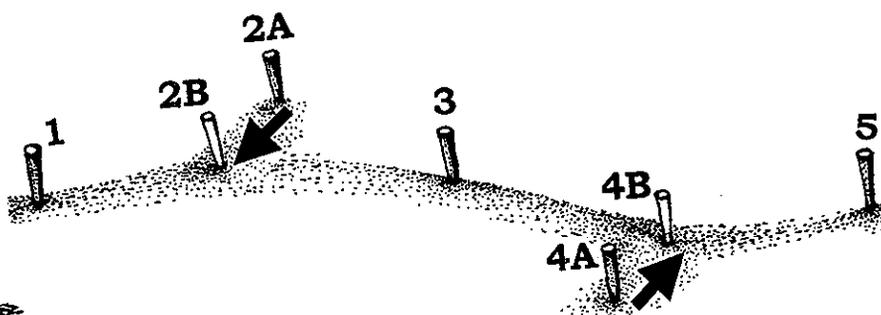
**When to smooth the contour line:** Smooth pegged lines only on **uniform terrain** by moving certain pegs in or out of the contour line as follows (see **Fig. 3**):

- A. Three people each stand by the first three pegs in the line (pegs 1, 2 and 3). Move the middle peg (no. 2) so that all 3 pegs are in a straight line.
- B. All three people then move two pegs forward i.e. to pegs 3, 4 and 5. Move the middle peg (no. 4) so that pegs 3, 4 and 5 are in a straight line. Repeat this process till the line is finished. The line will now be smooth, following the gradual curves of the contour.

**When not to smooth the contour line:** Do not smooth the contour line on irregular terrain as it could cause runoff problems.

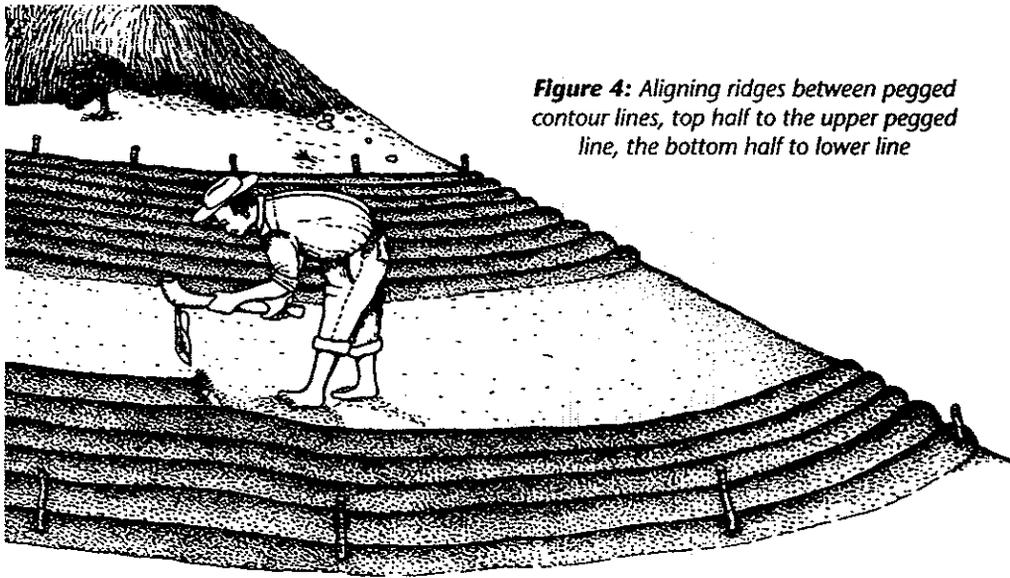
**Building marker ridges:** Build the pegged contour line into a ridge. The marked ridges simply serve as guides to re-align planting ridges and need not be bigger than other ridges if they are clearly marked.

**Re-aligning crop ridges:** After marker ridges are built, align crop ridges parallel to them. Use two marker ridges to align the enclosed area between them. To improve re-alignment on contour, align the top half of the area with the top marker ridge, and the bottom half with the lower marker ridge (see **Fig. 4**)



**Figure 3:** Smoothing the Contour Line





**Figure 4:** *Aligning ridges between pegged contour lines, top half to the upper pegged line, the bottom half to lower line*

### **Timeframe for Contour Ridging**

- ➔ **JUNE-SEPTEMBER:** After harvest and clearing, peg contour lines using a line-level and construct marker ridges
- ➔ **AUGUST-DECEMBER:** Re-align crop ridges when making new ridges for the coming season

---

## CHAPTER 2: VETIVER NURSERIES AND CONTOUR HEDGES



*A well established contour Vetiver hedge*

### **Plant contour Vetiver hedges to:**

- ➔ **reduce surface run-off and soil erosion**
- ➔ **increase soil moisture and crop yields**
- ➔ **supply thatching, mulch or bedding material for livestock**

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**Introduction:** Erosion and runoff from deforestation, overgrazing, fires, and poor agronomic practices threaten the environment and agricultural production. Planting perennial bunch grasses on the contour provides a good barrier against erosion and runoff. With proper spacing and management, natural terraces form between the contour hedges as soil moves from the upper side to the lower side behind the hedge. Contour hedges also slow down and retain water that would otherwise be lost through surface run-off. Multi-purpose trees or shrubs may be planted above the grass hedges.

**NOTE:** Grass hedges are used to reduce runoff and erosion, **NOT** to stabilise marker ridges which are simply guides to re-align ridges on contour.

**The Grass:** Vetiver is a fast growing, deep-rooted perennial grass well adapted to all agro-ecological zones in Malawi. It is not competitive with crops and is not known to host pests and diseases of concern to agriculture. Vetiver seed has low viability, so there is little chance of it becoming a weed. It is easy to establish and maintain, and it makes good thatching, mulch, and bedding material for livestock. *Vetiveria zizanioides* is the preferred species because it grows faster and forms a denser and more leafy hedge than *Vetiveria nigritana*.

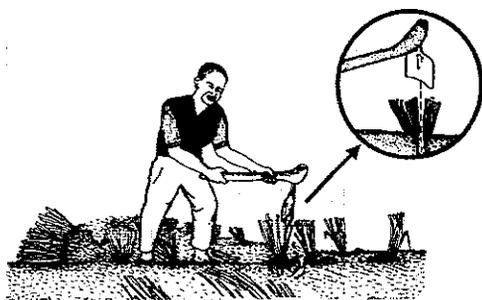
### **Collecting and preparing vetiver slips for planting:**

1. Collect planting material after the rains start, and plant within 48 hours.
2. Select healthy, well established clumps of grass.
3. Trim the grass to 30 cm tall before digging up (**Fig. 5**).
4. Make vertical cuts to dig out clumps with roots; leave 15% of each clump for nursery regeneration (**Fig. 6**).
5. Keep clumps upright in shade and away from wind to reduce drying out until planted. Water the collected planting material if it begins to dry out.
6. On the day of planting, trim leaves of collected clumps to 15 cm to reduce transpiration and to encourage tillering; then divide them into slips each with 3-4 tillers and 5-10 cm of roots (**Fig. 7**). The slips are now ready for planting in nurseries or along contour lines to establish dense hedges. Use larger slips with 5-10 tillers for planting inside gullies.





**Figure 5:** Trimming vetiver in the nursery



**Figure 6:** Digging clumps in the nursery



**Figure 7:** Trimming clumps and splitting

### **Nursery Establishment:**

Multiplication of vetiver should be done on a demand driven, community basis in line with the current policy of the Land Resources Conservation Department. Due to the short supply of planting material, encourage the establishment of local vetiver nurseries near planting sites before planting hedgerows in farmers' fields. Nurseries may be communal, individual or both, and small ones are easier to manage.



**NOTE:** A well established 0.1 ha nursery (Above) can produce sufficient slips to plant 5-10 km of hedgerows. If land is limited, establish small nurseries on the bottom areas of farms where the soils are deeper and less prone to drying out.

### **Follow these steps:**

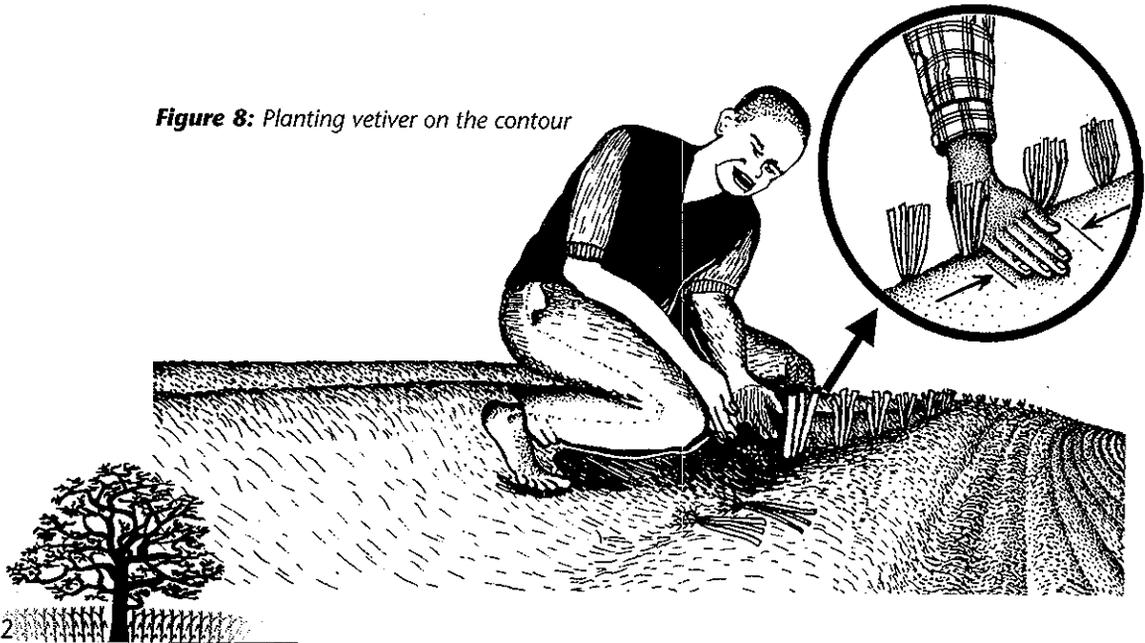
1. Choose dambos as the best nursery sites.
2. Collect enough clumps to plant the planned nursery. A fully loaded 7 ton truck will plant approximately 0.5 ha.
3. Plant early in the season for good growth so that planting material will be ready after one season.

4. Plant prepared slips 45 x 45 cm apart and press soil firmly around each slip; if farmers wish to intercrop beans or cowpeas on the ridges, plant the slips in the furrow 90 x 45 cm. Competition will be minimal because vetiver is newly planted or regenerating.
5. Trim vetiver to 30 cm tall 2-3 months after planting and again after the rains to promote tillering and fast growth (e.g., March and July).
6. When collecting planting material, leave 15% of each clump if there are plans to maintain or expand the nursery.

### Planting contour vetiver hedges:

1. Mark contour lines with a line level to re-align planting ridges (see **CHAPTER 1: CONTOUR RIDGING USING THE LINE-LEVEL**).
2. Plant slips 10 cm apart (hand width) in wet soil after the rains start in the furrow above the contour ridge (**Fig. 8**). Press firmly around each slip with its flat side facing downslope to encourage dense lateral growth which minimises gaps in the hedge.
3. Space vetiver hedges 5 m apart on steep land, 10 m on medium slopes and 15 m on gentle slopes. Hedges **need not** coincide with marker ridges which are used simply as guidelines for ridge re-alignment.

**Figure 8:** Planting vetiver on the contour



- 
4. Fill any gaps early in the season with slips 10 cm apart in a trench between the gap. Trim vetiver edges to reduce competition on the newly-planted material.
  5. Fruit and multi-purpose trees or shrubs may be planted 1-2 m above and parallel to vetiver hedgerows (e.g., msangu, mthete, nkunkhu, guava, peaches, mango, *Tephrosia* or pigeon peas).
  6. After good establishment, trim vetiver hedges to a height of 30 cm at the mid and end of the growing season to encourage tillering for a denser hedge.
  7. Use trimmings for thatching, mulch or bedding for livestock.

### **Timeframe for Vetiver Planting & Management**

- ➔ **JULY-SEPTEMBER:** Peg and build marker ridges after harvest; trim vetiver nurseries and hedges
- ➔ **OCTOBER-NOVEMBER:** Prepare nursery sites
- ➔ **DECEMBER-FEBRUARY:** Collect clumps from nurseries after trimming; prepare slips to plant in nurseries, on contour lines, and in gaps
- ➔ **MARCH-JULY:** After good establishment, trim vetiver nurseries and hedges to encourage tillering and fast growth

## CHAPTER 3: TREE NURSERY MANAGEMENT



*A well established village tree nursery*

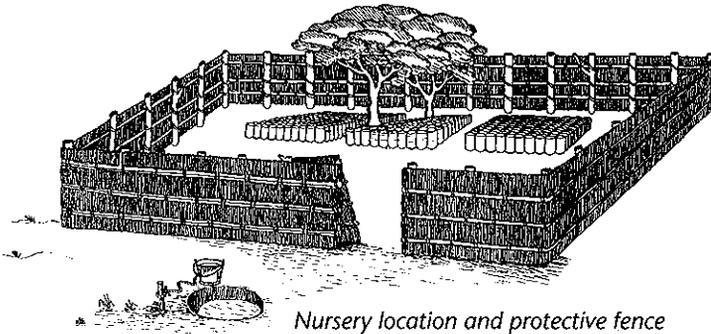
### **Establish tree nurseries for:**

- ➔ **raising tree species of your own preference**
- ➔ **production of healthy seedlings**
- ➔ **self-sufficiency in planting material**
- ➔ **cash**

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**Materials required:** Hoe, panga, watering can, grass and poles for fencing, topsoil, sand, manure, tree seed and polytubes or alternative pots like Chibuku cartons.

**Nursery location:** Choose level ground near permanent water close to the household or village for easy management. Hilly sites may require terraces stabilised with vetiver on their banks. Plan 10 m<sup>2</sup> with paths for every block of 1000 seedlings. Fence site to protect seedlings. Use other nurseries (e.g., for vegetables or tobacco) if possible to reduce the need to establish and care for new nurseries.



Nursery location and protective fence

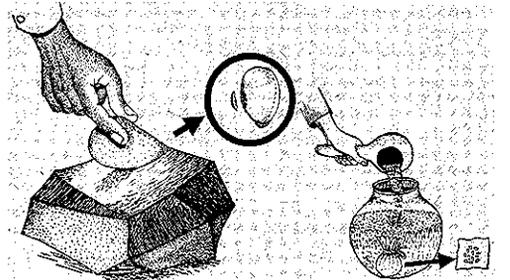
**Soil preparation:** Mix 2 parts soil to 1 part compost or manure, then add 1 part sand to improve drainage. For *Khaya nyasica*, mix 1 part soil to 2 parts sand and 1 part manure.

**Filling polytubes:** Wet soil mixture until friable. With open-ended tubes, fill the bottom 2 cm first and press against the ground to plug the bottom so that soil does not fall through the tube. Then fill

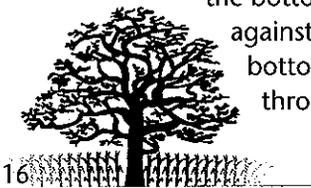


tubes right to the top and water them. Top up the tubes with nursery soil if needed. Arrange tubes in blocks of 50 x 10, or 100 x 10 for easy counting and management. Bank soil around each block to keep them upright and to avoid heat from the sun on the outer-most tubes.

**Seed treatment:** Treat seed as in **Table 1** just before sowing to allow fast entry of water into the seed for good germination. Some seeds need to be nicked with nail clippers or rubbed against a rough stone (below left), to remove a small part of the seed coat. Other seeds need soaking in cold water (below right). **NOTE:** Nick the side of the seed away from the micropyle.



Seed Treatment



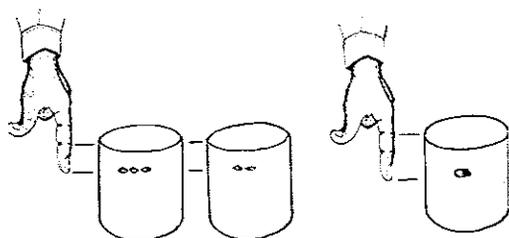
**Table 1: Treatment and Nursery Times for Common Agroforestry Tree Species**

Common Tree Species	Seed Treatment	Seeds/tube	Planting Depth	Nursery time
<i>Acacia galpinii</i> (Nkunkhu)	Nick	2	1.5 – 2 cm	8-12 weeks
<i>Acacia polyacantha</i> (Mthethe)	Nick	3	1.5 – 2 cm	8-12 weeks
<i>Acacia sieberiana</i> (Minganzolo)	Nick	2	1.5 – 2 cm	8-12 weeks
<i>Azelia quanzensis</i> (Msambamfumu)	Remove aril	1	4 cm	10-16 weeks
<i>Albizia lebeck</i> (Mtangatanga)	Nick	3	1.5 – 2 cm	8-12 weeks
<i>Albizia versicolor</i> (Mtangatanga)	Nick	2	1.5 – 2 cm	10-16 weeks
<i>Bauhinia thonningii</i> (Chitimbe)	Nick	3	1.5 – 2 cm	10-16 weeks
<i>Bridelia micrantha</i> (Mpassa)	Remove fleshy pulp	3	1 cm	10-16 weeks
<i>Cordyla africana</i> (Mtondo)	Remove fleshy pulp	1	3 cm	10-16 weeks
<i>Erythrina abyssinica</i> (Muwale)	Nick	3	1.5 – 2 cm	10-16 weeks
<i>Faidherbia albida</i> (Msangu)	Nick	2	1.5 – 2 cm	5-12 weeks
<i>Ficus natalensis</i> (Kachere)	Remove fleshy pulp	3	1 cm	10-16 weeks
<i>Gliricidia sepium</i> (Gliricidia)	Nick	2	1.5 – 2 cm	8-12 weeks
<i>Jatropha curcas</i> (Kamsatsi)	Remove from shell	3	3 cm	8-12 weeks
<i>Khaya nyasica</i> (Mbawa)	Remove from shell, soak 48 hrs	5	3 cm	10-16 weeks
<i>Leucaena diversifolia</i> (Lukina)	Nick	3	1 cm	8-12 weeks
<i>Melia azedarach</i> (Indya)	Remove pulp, soak 24 hrs	3	3 cm	10-16 weeks
<i>Moringa oleifera</i> (Chamwamba)	Remove from pod/shell	3	1.5 – 2 cm	8-12 weeks
<i>Senna siamea</i> (Keshya wa milimo)	Nick	3	1.5 – 2 cm	8-12 weeks
<i>Senna spectabilis</i> (Keshya wa maluwa)	Nick	3	1 cm	8-12 weeks
<i>Terminalia sericea</i> (Napini)	Trim wings	5	1.5 – 2 cm	10-16 weeks
<i>Toona ciliata</i> (Sendrella)	None	5-10	0.5 cm	10-16 weeks
<i>Trichilia emetica</i> (Msikidzi)	Remove aril	3	1.5 – 2 cm	10-16 weeks
<i>Ziziphus abyssinica</i> (Kankhande)	Remove pulp and crack nut	3 nuts	1.5 – 2 cm	10-16 weeks
<i>Ziziphus mauritiana</i> (Masawo)	Remove pulp and crack nut	3 nuts	1.5 – 2 cm	10-16 weeks
<i>Ziziphus mucronata</i> (Kankhande)	Remove pulp and crack nut	3 nuts	1.5 – 2 cm	10-16 weeks

**Sowing:** Sow all seeds directly into tubes.

**Table 1** shows the number of seeds per tube and depth of planting. **NOTE: Poor germination occurs if sowing is deeper than recommended. If seeds rise to the surface after watering, push them back down to the correct depth immediately.**

**Watering:** After sowing, water tubes every morning and afternoon. Continue until the seedlings are 3 weeks old. Thereafter, reduce watering to mornings only, but do not let the plants wilt. Avoid under or over-watering.



Number and sowing depth for different types of seed

**Thinning:** Thin tubes to one seedling per tube 2 weeks after germination. Do not disturb the plant that is left. Replant empty tubes as needed.

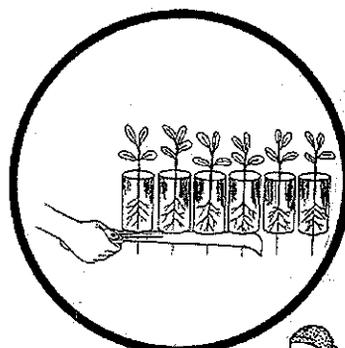
**Weeding:** Weed all tubes once a week from the time of first sowing.

**Root pruning:** Prune small roots growing through the bottom of the tube

by lifting tubes off the ground. Prune larger roots by sliding a sharp panga under the tubes. Root prune once a week with the final pruning 3-4 days **before** outplanting to allow recovery. **NOTE:** For msangu use air pruned seedlings raised on elevated platforms of wood and reeds (see diagram). This method allows nursery time up to 10 weeks without damage to the root system.

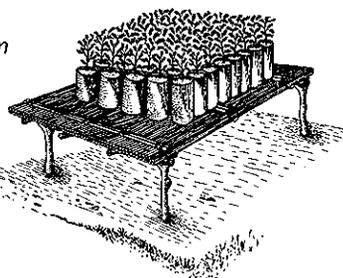


Root pruning once a week by gently lifting tubes off the ground



Root pruning once a week using a sharp panga

Local platform of wood and reeds to raise air-pruned *Faidherbia albida* seedlings.



### Timeframe for Nursery Activities

➔ **AUGUST:** Locate nursery near households and water supply; construct protective fence; collect seed, soil, sand, manure and polytubes

➔ **SEPTEMBER:** Prepare soil, fill tubes, treat and sow seeds, start watering, weeding and root-pruning

➔ **OCTOBER – DECEMBER:** Continue watering, weeding and root pruning



## CHAPTER 4: HOMESTEAD TREE PLANTING



*Well-established homestead trees*

### **Plant trees around the homestead for:**

- ➔ **fuelwood and building material**
- ➔ **fruits and animal fodder**
- ➔ **medicines**
- ➔ **shade**
- ➔ **live fencing to mark boundaries or to protect crops and enclose livestock**
- ➔ **income from sales of tree products**

**Introduction:** Homestead planting is the most popular form of tree planting in Malawi because it is easy to establish and manage, and generates many useful products and cash. Fruit and other multi-purpose trees can be planted as woodlots, on boundaries, or scattered around the homestead. **Table 1** lists some common natural and exotic trees and their uses.

**Raising tree seedlings:** Refer to **CHAPTER 3: TREE NURSERY MANAGEMENT**.

**Tree spacing:**

- Woodlots: 2 x 2 m for fuelwood; 1 x 2 m for poles
- Around homesteads: 4 x 4 m
- Along boundaries: 2 to 4 m apart
- Live fences: 0.4 m apart for hedges; 1 m for posts

**Planting pits:** Dig planting pits before the rains start (60 x 60 x 60 cm). Loosely replace the soil in the pits.

**Time of outplanting:** Plant seedlings with the start of the rains in the wet soil of prepared pits by mid December or early January. This encourages good root development for survival over the dry season. Choose a wet day for planting, preferably early morning or late afternoon to avoid midday heat.

**Method of outplanting:** Use a basket or box to carry seedlings to planting sites. Make a hole in the loose soil of your planting pit large enough to fit in the seedling. Remove the tube and place the seedling in the hole so the root collar is level with the ground; then firm the soil around the seedling with the heel of your foot. Add a double-handful of manure to the soil surface around each seedling to encourage good growth and establishment. (see illustrations on page 21)

**Weeding:** Cultivate 1 m<sup>2</sup> around the base of each seedling. Weed 3 times during the first season to improve growth, and to reduce risks of fire damage. Crops may be grown with the trees during this season to ensure weed-free conditions and efficient land use.

**Protecting your trees:** Erect a protective fence around each seedling if livestock are a risk. Mark other seedlings with stakes to minimise accidental weeding or trampling. Make firebreaks to protect woodlots and other plantings from damage by fires. In the event of disease or pest attacks, seek advice from the nearest Forestry Office.

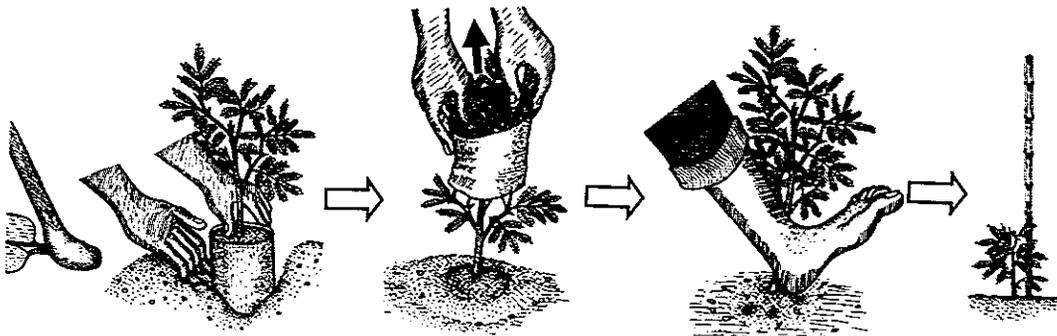




*Dig pit 60 cm deep and 60 cm in diameter separating the topsoil from the subsoil*



*Fill in the hole starting with the topsoil*



*Make a hole in the center of the planting pit, place the seedling in the hole, remove the container and then firm the soil around the seedling*



*Young seedlings protected against animals*



*Well-weeded young **Senna** trees*





Household woodlot of 4 year old ***Azadirachta indica***



Boundary planting with **Senna** 2 m apart

Table 2: Common non-fruit tree species for Homestead Planting and their uses						
Botanical Name	Local name	Fuelwood	Timber/Furniture	Fodder	Medicine	Growth Rate
<i>Acacia galspinii</i>	Nkunkhu	x	x	x		Fast
<i>Acacia polyacantha</i>	Mthethe	x	x	x	x	Fast
<i>Acacia seiberiana</i>	Minganzolo	x	x	x		Medium
<i>Azelia quanzensis</i>	Msambamfumu	x	x	x	x	Medium
<i>Albizia lebbeck</i>	Mtangatanga	x	x	x		Fast
<i>Albizia zimmermannii</i>	Mtangatanga	x	x	x		Fast
<i>Bauhinia thonningii</i>	Chitimbe			x	x	Medium
<i>Erythrina abyssinica</i>	Muwale			x	x	Medium
<i>Ficus natalensis</i>	Kachere		x	x	x	Fast
<i>Khaya nyasica</i>	Mbawa	x	x		x	Fast
<i>Senna siamea</i>	Keshya wa milimo	x	x		x	Fast
<i>Senna spectabilis</i>	Keshya wa maluwa	x	x			Fast
<i>Terminalia sericea</i>	Napini	x	x		x	Medium
<i>Toona ciliata</i>	Sendrella	x	x		x	Fast

### Timeframe for Homestead Tree Planting

- ➔ **NOVEMBER – JANUARY:** Dig planting pits at proper spacings before the rains; outplant seedlings in wet soil once the rains start, and clear 1 m<sup>2</sup> around each seedling
- ➔ **JANUARY ONWARDS:** Weed and protect seedlings from animals and fire





*Live fencing with **Acacia** trees 0.4 m apart*



*Fruit trees at 4 x 4m around homestead*

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## CHAPTER 5: UNDERSOWING *TEPHROSIA* *VOGELII* WITH MAIZE



*Tephrosia vogelii* is a fast-growing, nitrogen-fixing shrub adapted to many parts of Malawi

### **Undersow *Tephrosia* with maize to:**

- ➔ **improve soil fertility and crop yields**
- ➔ **control runoff and erosion**
- ➔ **suppress weeds to reduce loss of soil moisture and nutrients**
- ➔ **reduce crop damage from pests and *Striga***
- ➔ **produce fuelwood for domestic use**

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## Objectives:

- To improve soil properties for increased crop yields
- To protect soils from runoff and erosion
- To conserve soil moisture and nutrients
- To suppress weeds
- To reduce labour for land preparation and weeding

## Other benefits of *Tephrosia*:

- Suppresses *Striga*, a parasitic weed that attacks crops
- Controls common pests such as stalk borers, aphids, leaf eaters, termites, weevils and fleas
- Produces abundant fuelwood
- Seeds prolifically to reduce seed shortages

**Caution:** *Tephrosia* is a host to root-knot nematodes, so do not undersow or grow it in rotation with tobacco and other crops susceptible to nematode attack.

## Time and Method of Sowing:

Sow seed directly into the top of every ridge with the start of the rains **on the same day as planting the crop.**

*Tephrosia* does not compete with maize because of its initial slow growth. **NOTE:**

**Do not plant in furrows** as *Tephrosia* cannot tolerate waterlogging. **Failure to plant early** limits growth and makes

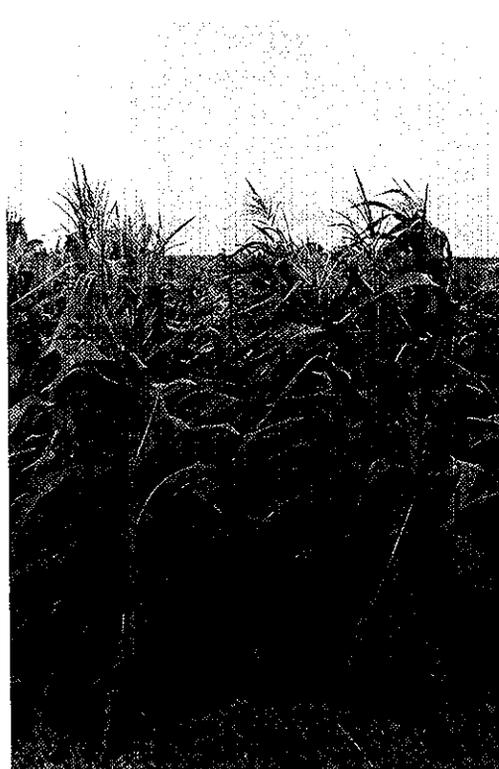
*Tephrosia* less tolerant to pests and diseases. This may make it necessary to retain the trees as a fallow in the 2nd season (see details that follow).

**Seed rate:** 5 kg/ha or 500 g for 0.1 of a hectare. This includes 10% to fill any gaps.

**Seed depth:** 1.5 to 2 cm. If seeds are planted too deep, they will **not** germinate.



Planting *Tephrosia* at the same time as maize

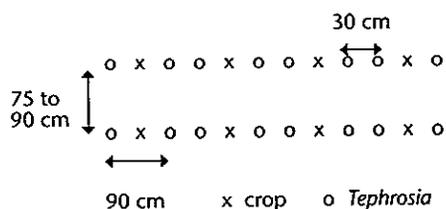


*Tephrosia* at the age of 2 months planted the same time as maize



**Seed density and spacing:** 24,691 stations/ha, or double the maize density; sow 3 seeds/station on every ridge in 2 stations 30 cm apart between maize stations.

Spacing of *Tephrosia* and maize:



**Weeding:** Keep fields free of weeds to improve survival, growth and biomass. Take care that the young *Tephrosia* plants are not accidentally weeded, especially by ganyu workers or young family members.

**Year of Harvesting:** The amount of biomass dictates whether to harvest *Tephrosia* after the 1st year, or after a fallow season in the 2nd year. Without good biomass, maize responses will be low. A good indicator of adequate biomass is a dense, vigorous stand with at least 75% survival and plants averaging 1.5 m tall or more.

**Replanting:** Fill gaps within 2 weeks of first planting.



*Tephrosia* in the 1st season at maize maturity

**Time of Harvesting:** At the time of land preparation, or just **before** the start of the rains in October or November.

### **Harvesting and Using *Tephrosia* biomass:**

- Cut down at ground level with a sharp panga or hoe.
- Lay the cut material uniformly over the soil surface.
- After a few days of sun drying, shake the leaves off and remove woody branches for fuel.
- Bury leaves and small twigs in the ridges or lightly cover with soil to minimise loss of quality from long exposure to hot, dry conditions.
- Do **not bury** woody stems as they tie up nitrogen which makes it unavailable to the crop.

**Annual Undersowing with no Fallow Period:** Target farmers who cannot afford to fallow any land. Undersow with maize when the rains start, and harvest biomass just before land preparation or the next rains. Continue this practice every year.

**NOTE:** Good crop and biomass results depend on **planting *Tephrosia* early**. Grow groundnuts every 3 years in rotation to reduce nematode risks and soil-nutrient demands from continuous maize cultivation.

**Undersowing with a fallow in the 2nd season:** Target farmers with adequate land to fallow, or land that is about to be left idle. Aim for a maximum of 10-20% of the farm area to be undersown each year. This will impact a large portion of the farm within 4-6 years. Improved soil fertility allows annual crop cultivation to resume in years 3 and 4. Then repeat the undersowing cycle starting in year 5. Although cropland is



*Tephrosia* in the 2nd season as a fallow crop. Note the dense canopy, low weed growth from poor light conditions, and high biomass.

Leaf material averages 3-5 tons/ha, and wood 7-10 tons/ha



lost for 1 out of 4 years, it targets only a small percentage of unproductive land (i.e., returns to labour and/or capital are low or negative). Gains in maize yields, wood and seed harvests should compensate for this loss.

**Seed Supply and Cost:** Supply of *Tephrosia* seed is short, so its wise use is critical. Seed is presently being bought from farmers at MK 10/kg. This excludes packaging, storage, transportation and supervision, which would raise the seed price to MK 20/kg.



Undersowing **Tephrosia** can more than double average farm maize yields of 1 ton/ha after the 3rd season of annual undersowing or after the fallow season (shown at right vs control at left)

### **Timeframe for Undersowing *Tephrosia***

- ➔ **NOVEMBER – DECEMBER:** Sow *Tephrosia* with maize on every ridge at the start of the rains; plant at the correct depth for good germination
- ➔ **AFTER HARVEST:** Leave *Tephrosia* to continue growing in the field after the crop harvest
- ➔ **BEFORE LAND PREPARATION:** Cut *Tephrosia* down at ground level. Bury leaves in ridges and remove woody stems. If biomass is low, keep *Tephrosia* as a fallow for the next season if you can afford the land

## CHAPTER 6: DISPERSED SYSTEMATIC TREE INTERPLANTING



*Vigorous maize under Faidherbia albida*

### **Plant trees in fields to:**

- ➔ **improve soil fertility and crop yields**
- ➔ **provide high quality fodder for dry season feeding**
- ➔ **supply fuelwood and building materials for household use**

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**Introduction:** Dispersed systematic interplanting involves planting trees with crops at a wide spacing to improve soil fertility and crop yields. Properly managed, this practice sustains farm productivity over the long term and provides other useful tree products. It is popular with smallholders because it builds upon traditional agroforestry practices, offering a range of trees species to meet different farmer needs.

**Types of trees:** Common species recommended are *Faidherbia albida* (msangu), *Acacia polyacantha* (mthethe) and *Acacia galpinii* (nkhunkhu). These are all large, fast-growing leguminous trees, indigenous to Malawi, and well adapted to a wide range of habitats. They also have multiple uses, and they are easy to raise from seed, sources of which are abundant and easy to collect. Other species commonly retained on cropland include: *Lonchocarpus capassa* (mpakasa), *Bauhinia thonningii* (chitimbe), *Erythrina abyssinica* (muwale), *Kigelia africana* (mvunguti) *Pericopsis angolensis* (muwanga), *Terminalia sericea* (napini) and various *Ficus* species such as kachere and mkuyu.

**Note on *Faidherbia Albida* (Msangu) trees:** This tree is particularly beneficial for soils and crops from its unique feature of dropping nutrient-rich leaves when the rains start. Its bare canopy and leaf fall during the growing season offer soil and light conditions ideal for good crop growth. Farmers in Malawi and elsewhere in the region have

maintained crop yields beneath msangu trees for long periods without adding fertilizers. Maize production under mature trees is commonly 50% to 250% higher than outside the canopy. Variation in yield depends on the crop variety and husbandry practices used, especially time of planting and weeding. Msangu also has other uses including fuelwood and building material, shade during the hot dry season, and high quality fodder from its abundant production of nutritious pods.

**Nursery Practices:** Follow nursery practices and seed treatments described in **CHAPTER 3: TREE NURSERY MANAGEMENT**. Time nursery sowing so that seedlings are ready to outplant with the start of the rains. Note that msangu needs only 5-10 weeks in the nursery before outplanting.

**Planting Pits:** Dig planting pits before the rains start (60 cm diameter x 60 cm deep). Loosely replace the soil in the pits.

**Tree Spacing:** 10 x 5m for outplanted nursery seedlings.

### **Outplanting of Nursery**

**Seedlings:** For most species, nursery seedlings are recommended for outplanting into prepared pits.

**NOTE:** for msangu always use air-pruned seedling raised in large containers.

**Time of Planting:** Outplant seedlings into prepared pits by mid December or early January. Choose a wet day to plant, preferably early morning or late afternoon



to avoid midday heat. Early planting encourages good root development for survival over the dry season. It also helps seedlings to resist common pests and diseases. **NOTE:** Poor performance in the field occurs from (1) late outplanting (2) using overgrown seedlings that have stayed too long in the nursery, and (3) incorrect techniques when outplanting.

**Replanting:** Replant any seedlings that have died. Do this within 2 weeks of first planting to ensure a good stand of trees.

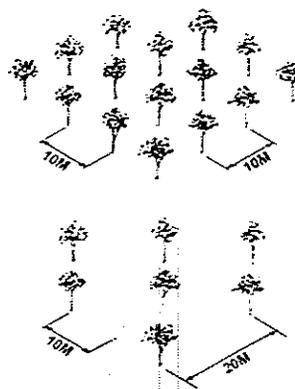
**Weeding:** A well weeded crop during the first season will benefit the seedlings by reducing competition for soil moisture and nutrients, as well as risk of fire damage.

**Protecting your trees:** To reduce losses from accidental weeding and trampling, use a stake or peg to clearly mark or identify the location of each seedling. If livestock are a risk, erect a protective fence around each seedling. In the event of disease or pest attacks, seek advice from the nearest Forestry Office.

**Thinning:** Thin trees as they grow in size to prevent overcrowding and to provide wood and fodder (**Fig. 9**). Follow the thinning regime in **Table 3** which shows the spacing and density for trees of different size.

**Table 3: Thinning regime after the initial 10 x 5m spacing with 200 seedlings/ha**

Tree canopy radius	Recommended Spacing	Recommended Density
5 meters	10x10 m	100 trees / ha
8 meters	10x20 m	50 trees / ha
10 meters	20x20m	25 trees / ha
> 10 meters	Increase spacing by selective thinning and pruning branches	~20 trees / ha



**Figure 9:** Results after thinning (from 10x5 m to 10x10 m and 10x20 m)

**Pruning:** Prune bottom branches of seedlings after the first season to promote straighter, healthier trees, and to reduce interference with field operations. Time pruning when trees begin active growth to reduce die-back, fungal diseases and termite attack (*Faidherbia albida*: April-May; **other trees**: September-October). Make clean angled cuts with a sharp blade or saw to reduce injury to the tree.



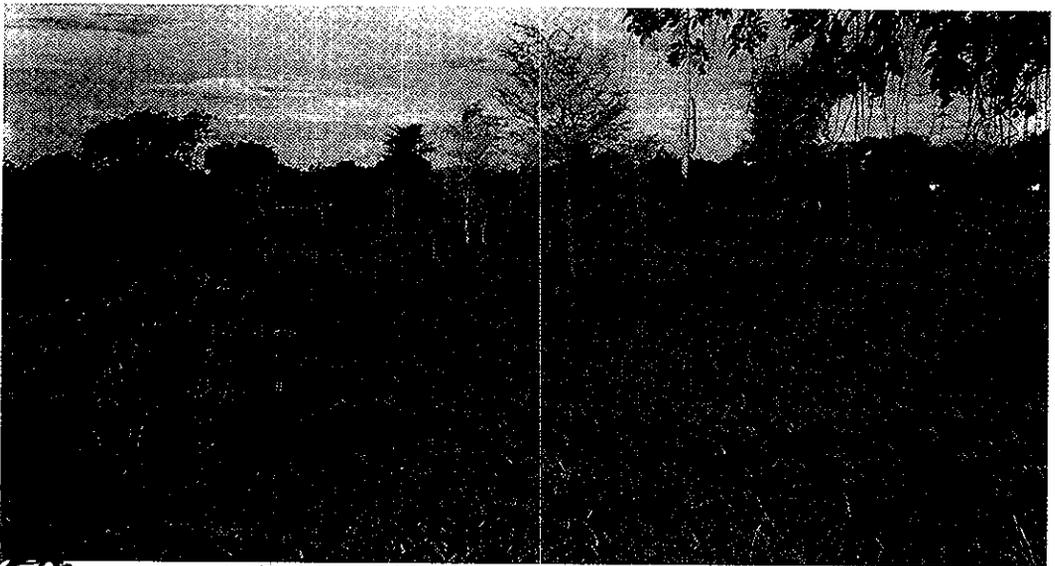
**Figure 10:** Pruning a young tree to improve its growth form.

As trees grow to maturity, a few branches may be selectively lopped to prevent canopy closure and to supply wood and fodder.

**Naturally Growing Trees:**

Farmers may leave natural trees on their farms. Choice of species depends on individual preferences. Natural trees need care from weeds, fires and

animals just like planted ones. As they grow in size, they also need management to minimise shade effects on crops, and to supply wood and other products desired by the household. Pruning is best done just before the start of the growing season, but take care to avoid over-pruning which retards the ability of trees to regenerate.



Young **Faidherbia albida (msangu)** trees in a maize field showing good weeding and pruned lower branches





Naturally growing **Faidherbia albida** (**msangu**) trees in cropland

### **Timeframe for Dispersed Systematic Tree Interplanting**

- ➔ **AUGUST - NOVEMBER:** Prepare nursery, collect inputs and raise air-pruned seedlings; identify outplanting sites and dig pits at the right spacing
- ➔ **NOVEMBER – JANUARY:** Outplant seedlings in wet soil with the rains; to reduce losses from accidental weeding and trampling, use a stake to clearly mark each seedling
- ➔ **JANUARY ONWARDS:** Keep seedlings well weeded with the crop; protect seedlings from animals and fire during the dry season
- ➔ **START OF NEXT SEASON:** Prune lower branches to encourage an upright growing habit and to minimise interference with cultivation practices