



EXPORT PROMOTION OF
ORGANIC PRODUCTS FROM AFRICA

Organic lemon grass - A guide for small holders



Organic lemon grass



EPOPA (Export Promotion of Organic Products from Africa) is a development programme initiated by the Swedish International Development Cooperation Agency, Sida, in 1997.

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A female lemon grass grower with her family



Lemon grass with a good layer of mulch



First grade lemon grass for herbal tea



Treadle pump in action on a field day



Tree nursery



Compost tea



A simple drying shed from the outside



A simple drying shed on the inside



Harvesting of lemon grass

1. The keys to get a quality lemon grass crop

1.1. Introduction

Growing a crop can be done in a lot of different ways. This manual will give you some ideas to improve your lemon grass crop.

Lemon grass (*Cymbogon citrates*, is one of the species that one can use for commercial production) is a tropical grass type originally from India. It derives its name from its strong fresh lemon scent. In Africa, it is quite often used as an ornamental plant. It is a tufted perennial grass with numerous stiff leafy stems arising from short rhizomatous roots. The leaves can grow up to a height of 2m. It is a perennial crop and has an economic lifespan for about 5 years.



Picture 1. some cosmetic products with lemon grass oil

Different parts of the plant can be used for a wide range of purposes. The grass is used by traditional healers to treat various diseases and infections. The stem is used in culinary dishes, often in the Asian kitchen. Dried Lemon grass is mainly used in herbal teas. From the leaves oil can be extracted which is used in the fragrance industry as a cheap delicate scent. Fractions (example citral) of the oil are of interest for the beverage market for example lemonades and lemon essence.

1.2. Basic Agronomy

Soil and climate vary in the various regions where the grass is grown. The manual will give some specific details for different types of soils and climates.

The plant grows on a wide range of soils. The best yields will be obtained from well drained sandy to loam soils, with a pH value ranging from 4.3 to 8.4 and with access to water throughout the year, it can give 3 - 4 harvests. Often the grass is grown on poor soils or erosion sensitive areas. Yield and oil content are influenced by the soil conditions. Poor soils will give low yields and short economic lifespan. Fertile soils will give higher yield but lower oil percentage and citral content.

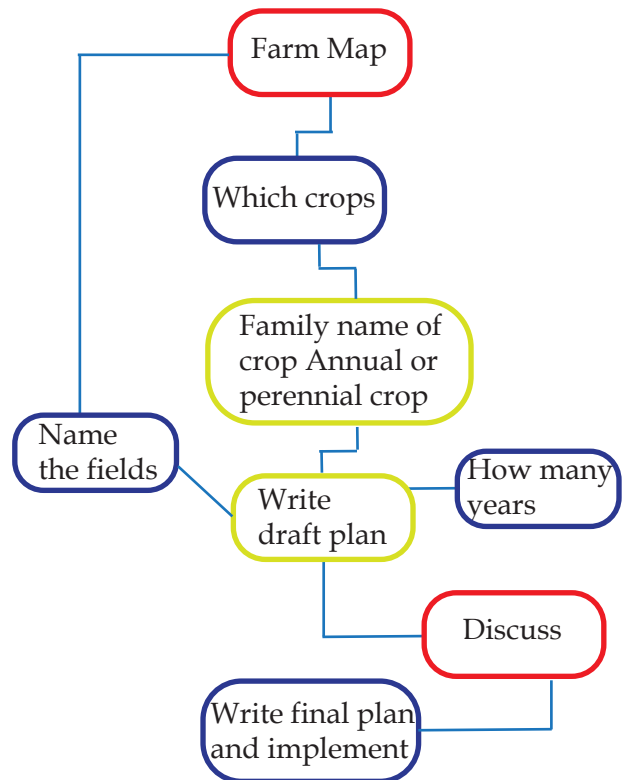
Under very humid conditions rust might be a problem. Under dry-land conditions the crop will produce 1-2 cuts a year in the raining season. Without water it will, through its deep rooting system, survive until the next raining season. The grass might look dead, the grass can't produce a crop but will shoot again as soon as the rains start. The grass does not withstand water logging. In Zambia it is, under commercial circumstances, successfully been grown in the cooler plateau upland areas and in the hot river valleys of Siavonga.

2. How to cultivate

2.1. Make a cropping plan

When you start with cultivating your land it will help you if you plan your fields. This will help you to reduce the pest and diseases, improve your soil management and your logistics. Start with the **map of your farm**. Look at the land which you have divided in different fields. Name or number each field. Avoid the same crop or family (example given tomato and potato, solonacea family) after each other in two consecutive years on any particular field. For the cabbage and potato it is wise to keep a minimum period of three years before you grow the crop on the same field again (because of eelworm and foot-rot). Make a cropping plan for at least three years and maximum five years. These are the steps taken to make a proper plan:

- Write down the names of the plots
- What crops do you want to grow, what do you want to achieve
- Divide the crops in families and in annual/perennial crops
- Decide for how many years the plan is
- Write the plan down and discuss with your family, neighbour and/or extensionist.
- Write down the final plan.

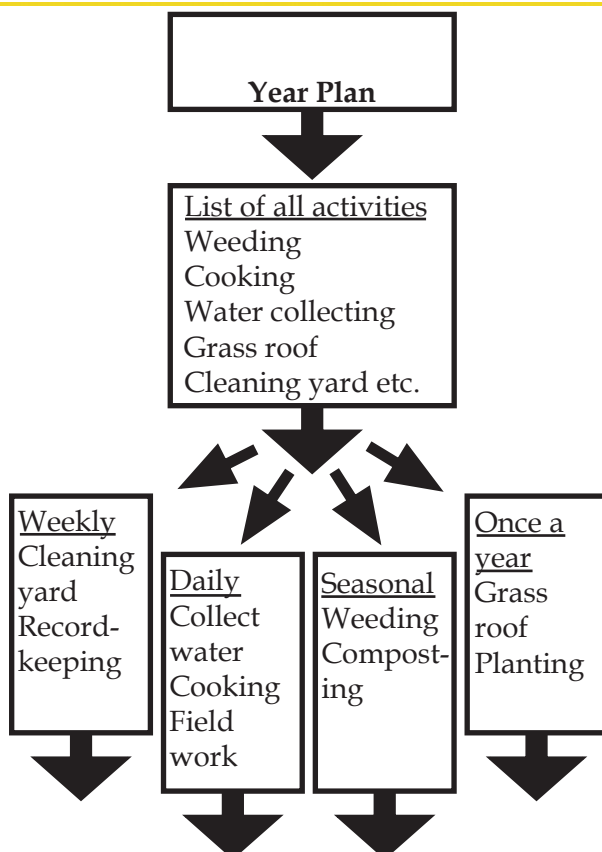


Schedule 1: Cropping plan

The plan is a guide to your farming plan. If there is a change (it might be possible that you don't have the seed or that there is a new interesting crop) then look at your plan and see if the crop can be changed without any problems (e.g. diseases or pests).

2.2. Year plan

After the crop plan is made the next step is to make a plan for the coming year. If you do this every year it can help to reduce the work load on one period. If there are meetings, funerals, field days or other things which are not in the plan then you can have a look in the weekly planning and the real situation so that the less necessary work can be skipped or reduced and done next week.





Schedule 2 : Year plan

- Make a list with all the things you have to do on the farm (planting, weeding, new grass roof, cleaning the yard etc)
- Divide the activities in groups (e.g. which come back every week, seasonal activities, once a year activities)
- Try to calculate how much time you need for every activity.
- Make a plan for the weekly activities (e.g. each Monday clean the yard each Tuesday and Friday you treadle, each Wednesday you check your animals)
- Make a seasonal plan. (When do you want to plant your maize, cowpeas, lemon grass, etc). When do you want to weed in which crop (if you use a green manure the weeding will be less)
- Write your year plan.

2.3. Plant material

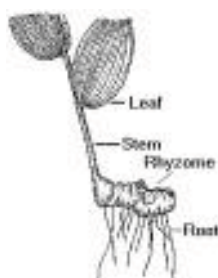


Figure 1. different parts of the plant

The plant material should be fresh and disease free. The plant is propagated by means of division of the pruned rhizome or slips (splitting the root clumps). Thus the mother plant should be healthy and fresh. A mother plant can give up to 20 new plants. The plant should be cut back to 20 cm. The rootstock should be propagated in the nursery. The best time of the year to obtain new rootstock is two months before the raining season, so that the plant is mature enough to transplant in the field, just before the rains start. Spacing in the nursery will be about 10*10. Use mulch which is disease and seed free to cover the ground in between the rows.

2.4. Preparing the Land

There are several ways to prepare the land. The ones advised underneath are the most land preparation methods is also possible (e.g. After you prepared the basins, conservation farming can be done).

Pot holing



Picture 2. Potholing on the left the holes are wrong while the pothole on the right is the way it should be

Useful in dry areas without irrigation. Prepare the land before the rains start. Use a hoe to dig a hole of 20 cm deep. The hole should be 30 cm long and has the width of the hoe blade. Put compost in the hole and plant the lemon grass in the hole after the first effective rains. To intercrop you can plant one line of lemon grass, a line of legumes, a line of lemon grass, and a line of vegetables. Repeat this process in the field. Use always the same hole and don't disturb the soil besides the hole.

Ridges



Figure 2. ridges

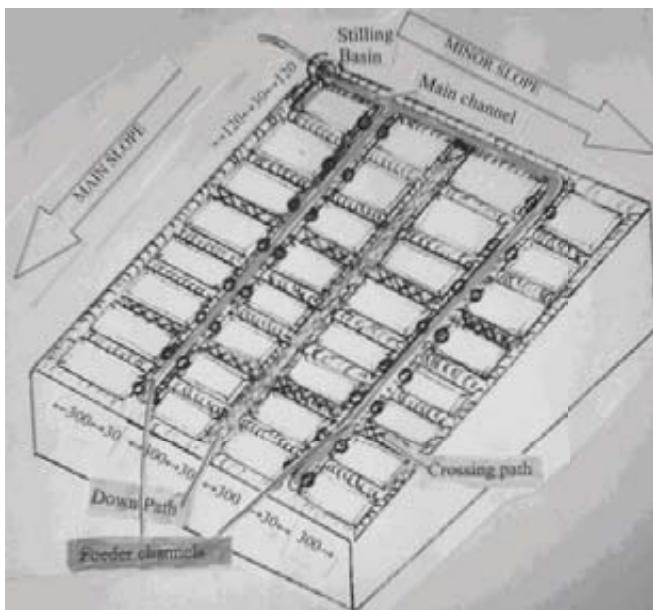
This type of land preparation is suggested if there is a change of water logging. Normally this is the case when the soil is a heavy clay type soil. The plants should be 30 cm apart within the ridges. And the ridges are 30 cm apart from each other. Intercropping can be done as above (a line is in this case a ridge). Potholing on the ridges is also possible.

Basin

This type can be used as raised basins on heavy soils or as an irrigation basin. The explained preparation of this method is for the irrigated basin. You make basins of 300 * 120 cm (picture 4) each basin has a level surface so that the water can flow evenly through it. The ridges around the basins are 20 cm high. Prepare the land as shown in picture 4. Take care of the irrigation canals (Use heavy dambo clay to strengthen the canals) and the paths. Intercropping can be carried out as follows: one bed lemon grass, one bed vegetables/maize, one bed lemon grass, one bed legumes. Alternatively; within a bed two rows of lemon grass and in the middle a row of vegetables/maize or legumes. The plant distance should be 30 cm and 45 cm between the rows. A treadle pump can effectively irrigate up to 3,000m². However, 1500 m² is recommended.

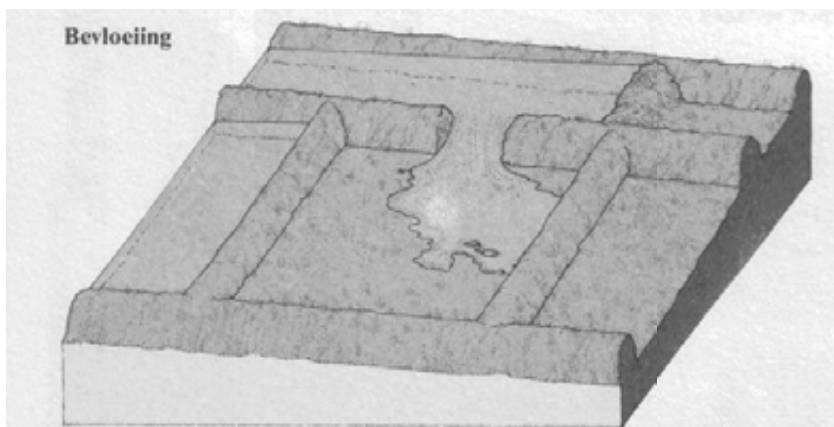


Picture 3. The layout of the basin is wrong.. The water is not floating equally over the bed. Improved leveling is needed



Picture 4. Layout of a basin irrigation system

- Note 1: Smoothen the stilling basin this is where the irrigation pipe is entering the irrigation system
- Note 2: Secure the free end of the delivery hose with sticks to ensure that it stays in the stilling basin.
- Note 3: Use plastic bags filled with sand or earth walls to force the water into a direction
- Note 4: Always irrigate one basin a time.



Picture 5. irrigation of basins

2.5. Water supply



Picture 6. How does the plant lose water through transpiration.

Water supply depends on the soil type, the crop and the growth stage of the crop. The critical stage of lemon grass is at the nursery, during transplanting and after harvesting. Use of mulch and compost will increase the water storage capacity of the soil. Irrigate in the warm season every 7-10 days and in the cold season every 10-14 days. During the rain season it is important to keep track of the frequency of the rains. If the rain is frequently enough and the soil contains water no irrigation is needed. However if no rains have been received for a period of 10-14 days after the last rain then irrigate. As a guide, if you can't mould a weak ball from the soil (except sandy soils) sample (taken from the soil until root depth) or the leaves are discoloring or wilted in the early morning then irrigation is necessary.

Do not wet the soil below root level. The roots of a plant are generally as long as the height of the plant. It is the depth of its rooting system which enables the plant to withstand drought conditions, therefore don't irrigate more than advised as this will stimulate a surface root system. Look for the amount of water supply for lemon grass in table 1.

Lemon grass stage →	Nursery/1st month	2nd month	3rd month and later
Soil type ↓	root ≤ 50 cm	root = 100 cm	root ≤ 150 cm
Clay or loam	4 cm	8 cm	12 cm
Sandy loam	3 cm	6 cm	9 cm
Sand	2 cm	4 cm	6 cm

Table 1 water supply to lemon grass

Note: with intercropping, keep in mind what root depth the other crop has.

2.6. Intercropping

Lemon grass is a perennial crop, it will give a good commercial yield for the first five years. Lemon grass suits itself very well for intercropping. With basin irrigation you can grow a crop in between the lines just before planting or together with planting of the lemon grass. After that it not wise to grow a crop in between. Just after harvesting, a nitrogen fixing plant can be intercropped. A different possibility is to grow on each second basin another crop. Make a cropping plan for five years within the lemongrass plot.



Picture 7. Different heights of plants, with intercropping.



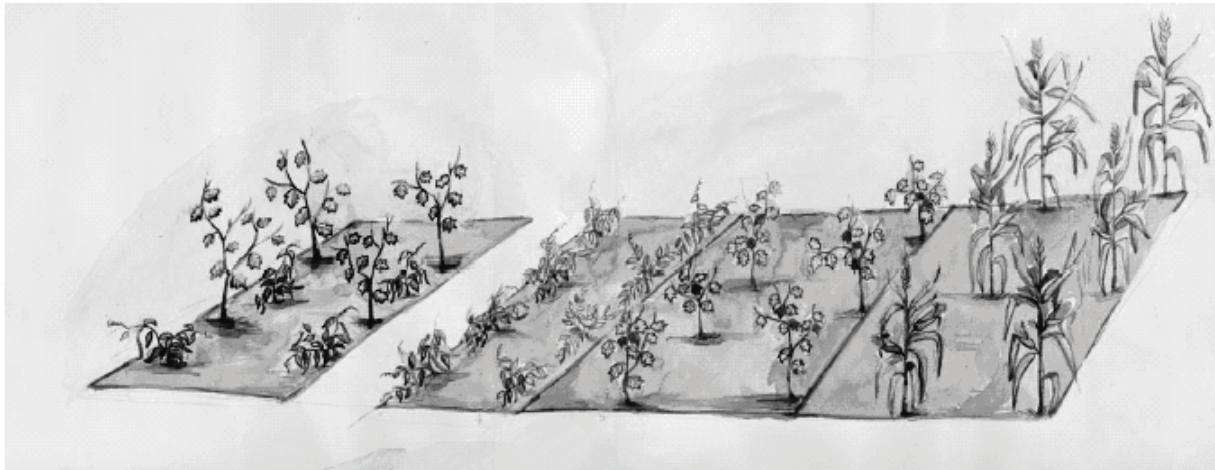
Picture 8. Good mulching and intercropping in lemon grass

In the following table, you find a suggestion of different crops which you can grow:

Crop 1	Erosion control crop	Nitrofixing plants	Crop 2	Phosphate fixing plants
Maize	Lemon grass	Sunhemp	Tomatoes	Pigeon peas
Cassava	Vetiver grass	Peas	Cucumber	Comfrey
Sweet potato	Moringa	Beans	Potato	
Sunflower	Desmodium	Groundnut	Eggplant	
Onion	Leuceana	Soya bean	Pumpkin	
Spinach	Sesbania	Lucerne	Paprika	
Cabbage	Acacia	Lupine	Okra	

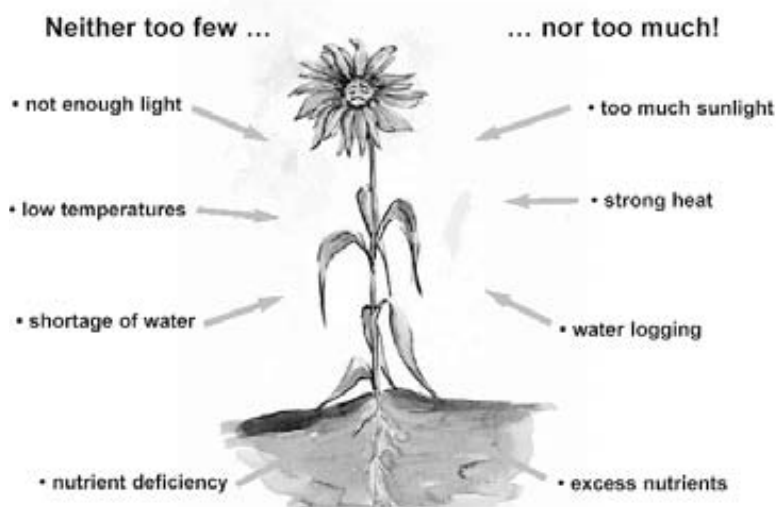
Table 2 possible crops for intercropping and crop rotation

Never plant the crops within the “crop” column the following year on the same field. This might cause pest and disease problems. It is important to practice a good crop rotation because of the many benefits that come along with rotating crops. Crop rotation helps to break the life cycles of pests and ultimately avoids a repetition of disease attack. You can companion crop 1 and crop 2 (e.g. tomatoes with cabbage). After a crop, you plant or rotate with a nitrogen fixing plant on that field. Be aware that some plants might attract white flies which may cause problems to the lemon grass (In Zambia it is not yet noticed as a pest in Lemon grass).



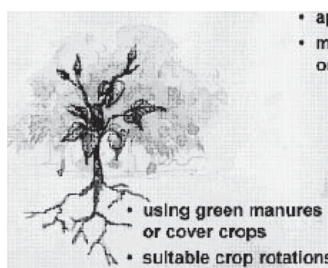
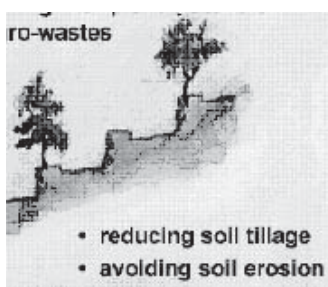
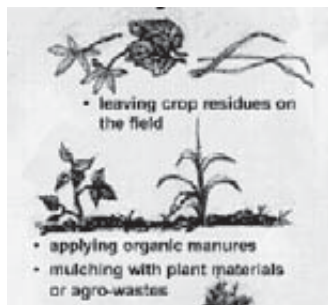
Picture 9. Fields with different crops, to rotate and improve the soil the following planting season other plants should appear in the field (e.g. where maize was next time you plant beans)

Factors influencing plant health



picture 10 What can influence the health of the plant

3. Soil management



Soil management means taking care of the soil. When crops are planted on the land they grow and take all kind of nutrients out of the soil. When the crop is harvested and taken away the nutrients are also leaving the land. So this means that the land will be exhausted after a year or two. The soil becomes poor and the yield will be drastically reduced. Some guidelines to overcome most of this problem can be found in this chapter.

3.1. What is your plant telling you?

If you look at your plant it can tell you if there is a nutrient deficiency problem in your soil. Deficiency problems might not always been easy to diagnose but in this paragraph the most easily detectable deficiencies are explained and you can see them on the picture 44 at of the end of this the book.

Deficiency might have to occur when the pH of the soil is not neutral. When the soil is acid add lime if the soil is acid add gypsum or magnesium sulphur. In the table shown underneath you find the influence of the pH on your Nutrient availability.

pH	Strong acid			Acid medium	Acid slight	Acid very slight	Neutral	Alkali very slight	Alkali slight	Alkali medium	Strong Alkali		
	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Nitrogen	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Phosphorus	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Potassium	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Sulphur	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Calcium	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Magnesium	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Iron	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Manganese	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Boron	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Copper & zinc	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
molybdenum *	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red

Picture 11. How to increase the content of soil organic matter

* molybdenum is a kind of immuom booster for the plants if deficiency then there is tissue weakness

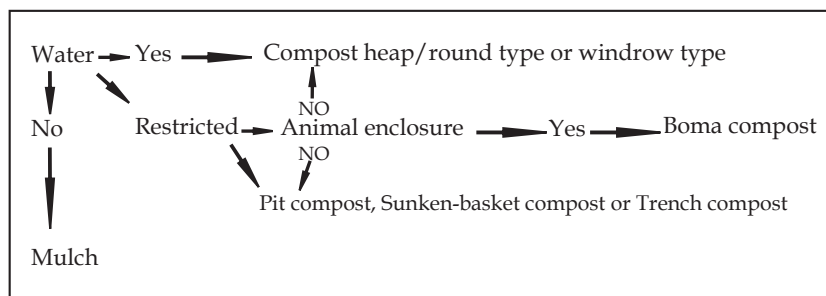
- sufficient availability of the nutrient
- availability of the nutrient
- marginal availability of the nutrient
- little availability of the nutrient
- very little availability of the nutrient
- very little availability because of absence of complimentary elements and the soil interaction

** when the line gets thinner this means also less availability

Schedule 3. How Soil pH influences the availability of plant nutrients

3.2. Composting

There are lots of ways to make compost. Here are the methods recommended in Zambia. Follow the chart and then you will know which one suite your particular conditions and farming system.



Schedule 5. Which compost methods is the best for what situation



Schedule 4. The circle of compost

Table 3: Layer of stages and steps to make good compost. In the first column of the table you find after the text a * this means that you have to water the material after this layer is finished until it is partially soaked.

Method → ↓ Action	Chinese	Boma	Windrow	Trench (only perennial crops)	Sunken basket (perennial crops)	Pit
Digging depth	Top layer (5cm)	30 cm	Top layer (5cm)	60 cm	45 cm	≥100 cm
Layer Size	Ø 75 cm	Should meet the manure supply	200*150 cm	Length of the crop row X wide of space row	Ø 45 cm	≥100*100- ≤150*300
1st stone grid	. --	--	--	--	--	5 cm
2nd Rough dry vegetation e.g. Maize stalks, twigs, *	20 cm	20 cm	20 cm	15 cm	15 cm	45 cm
3rd manure, *	3-5 cm	10 cm	3-5 cm	3-5 cm	Mixture of both	3-5 cm
4th Green /fresh plant material and sprinkle topsoil on top,*	20 cm	---	20 cm	15 cm		20 cm
5th push a stick into the heap at an angle that is higher than the total height of the heap for heat and moisture monitoring. When stick gets dry add water, when mould (white substance) on stick turn heap						
6th Repeat step 2-4 until max. height is reached	150 cm	120 cm	150 cm	Ground level	Ground level	Max 100 cm
7th cover heap totally with banana leaves, dry grass. In dry season with mud and topsoil						
8th Turn heap	Every 6th day in 3 layers. (A,B,C) C will go to place A in heap B to C and A to B.	After 2–3 weeks turn in other pit. 2nd time after 2-3 weeks. Ready when stick is cold.	When heap is cold, or stick has white substance or maximum after 3 weeks	NO turning. Add new mulch after sometime. Next time use other trench	NO turning water only the basket	When heap is cold, or stick has white substance or maximum after 3 weeks
9th Ready for use	18-21 days	6-9 weeks	4-6 weeks	Straight	Straight	4-6 weeks

You can organize permanent air supply by adding a tube from a bunch of maize stalks or from metal wire or a perforated tube on different places (65cm apart) in the heap.. A pile of 5-10 cm sunflower stalks at the bottom of the pile coupled with the partial digging of the soil surface leaves real air channels, enabling the heap to 'breath' (same principal as a fire)..



Picture 12. Pit method

How does composting help?

Adding compost to the soil increases the level of organic matter – humus which is in very short supply in the majority of Zambian soils. The effects are long lasting and the main benefits include;

- Plants are supplied with increased levels of nutrients leading to better yields
- The soil is able to store moisture for longer, helping to protect the crop from drought
- Soil structure is improved, making it less vulnerable to erosion.



Picture 13. Boma method

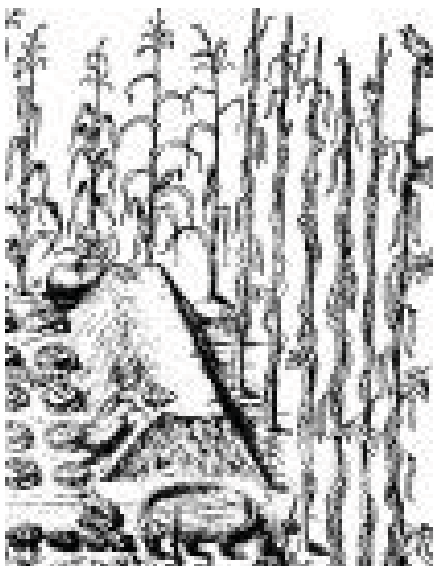
Even **if manure is in short supply**, a little should be added to the compost heap as an activator – 'to get things going'. If manure is in short supply, adding a little mature compost from an old heap or rich forest soil (i.e. with high micro-organism content), urine, comfrey liquor and bone/ blood meal will help to accelerate the compost making process.

Don't add: Synthetic material (plastic, tins,)

- » Synthetic chemicals
- » Plant material infected with virus diseases or pest-laden
- » Aggressive colonizing plants, seeds or roots
- » Bones, meat, eggs, grease
- » Material thicker than ¼" (e.g. cut trunks always before adding)

Material you can add: Lime (if PH of soil is not above 8),

- » Good soil and earth from termite mound,
- » Ash (don't mix with manure, add after the first decompose phase), Grass (also from the roof), kitchen waste,
- » Manure (never add manure straight to the plant.),
- » Leaves (no eucalyptus, avocado or mango, they take too long to decompose),
- » Groundnut shells, Kitchen waste, sweepings
- » Bone-meal, eggshell,
- » Legumes

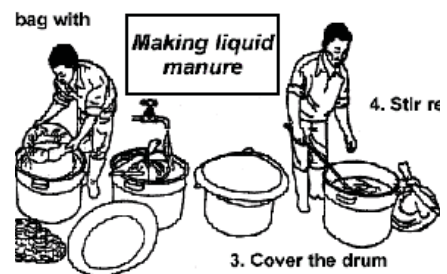


Picture 14. Windrow compost method

Pointers:

- Partly composted material helps loosen **Clay soil**
- Very well composted material helps **Sandy soil** to keep water and nutrients
- When the heap remains cold then check if it is too dry (add water) or there may not be enough Nitrogenous material in the heap (add fresh manure, leguminous vegetation)
- If the heap smells sour it could mean that there is not enough oxygen throughout. This could be due to too much water (add dry plant material) or through compaction of layers (Turn the heap to ventilate)
- If the heap is too small it will only be moist and warm in the middle, therefore much of the material will not be composted (too much outside area in relation to inside area results in too much oxygen).

- Build the compost heap of free draining land and in the shade
- You learn through experience, practice makes perfect.
- **Material which is large and woody** will take longer to break down. It will help if you break this material up before including it in the compost
- Moisture is necessary to help the compost break down. Regular watering in the dry season is needed. Think on this for the position of the compost heap.
- Air is needed for decomposition; the compost should be turned occasionally to allow air to be trapped preferably once every two weeks. Compost should never be allowed to stand in water.



schedule 6. Preparation compost tea liquid manure or fertile tea

- Collect green sappy leaves or put manure or compost in a bag
- Immerse with fresh water
- Cover the drum
- With manure tea or compost tea stir regular
- Dilute 2 : 1 with water

Application

Apply the compost when it is ready. At this stage it looks dark-brown, carries a good smell and feels crumbly (you can pulverize bigger parts). The temperature is uniform with the surrounding and it is composed of at least 25-30% of organic material.

Apply the compost (5cm) in to the ground (15-20 cm deep) a few weeks before planting. If the plants are already established you add the compost (3 cm thick) around the plants in to the top layer of the soil. Cover it with mulch.

A special mixture (1/3 sieved compost, 1/3 soil and 1/3 coarse sand) is used for seedlings

Liquid manure, compost tea or fertile tea is very useful for seedlings and transplanted material. Mix one part compost, manure or green leaves with five parts of water, stir a few times and leave it for at least 7 days. For a stronger mixture fill a drum with water approximately 200 litres. Put compost into a 25 kg sack. Immerse the sack in water whilst hanging from a rode laid on top/mouth of the drum. Shake the hanging sack every two to three days for a period of two weeks. (this might be a good compost solution for the dry season & a quick source of nutrition when added as a drench).

3.3. Green manure

Many plants (e.g. legumes, fenugreek, clover) can be grown as green manure This method helps retain moisture and prevents sheet erosion, helps break up clay, bind sandy soils, store available nutrients and protects soil structure.

The green manure should be cut before it sets seed. If it is a tall green manure species such as Sunhemp then cut it down when it reaches the same height as the lemon grass. Legumes make the best green manures (Cow peas, Lucerne, groundnuts, velvet beans, pigeon pea, Sunhemp, etc.) as they improve the available nitrogen in the soil or other crops (sorghum, elephant grass, Sesbania, rye, millet, mustard, sunflower) which are producing large quantity of plant material, above and below the ground.



Picture 15. Compost Tea preparation



Picture 16. Velvet beans are a good green manure and soil improver

Don't mix the green manure into the soil as it will cause a lock up of nutrients temporarily. Also opening up the soil allows nutrient loss. Leave it as mulch on the surface of the field; this will also protect the soil from the harmful effects of the sun.

Use green manure in your crop rotations to increase the difference in nutrients. These crops bring leached nutrients up towards the surface where the crop plants can reach it. Green manure contributes greatly to increasing the organic matter in the soil. It is also a very good erosion control method.



Picture 17. Pigeon Pea is another good green manure and soil improver

3.4. Legumes

These plants are very helpful in fixing nitrogen out of the air. The most common are the groundnut, beans and peas for consumption. These plants can also be very useful as green manures though you might want to consider the opportunity cost of slashing them down to having them as food. However, they fit well in the rotation plan. Legumes which are primarily planted as green manure are Lucerne, Sunhemp and cow pea. There are also some leguminous trees and shrubs as well. The leaves of these trees/shrubs are very good as leaf compost or green manure. The common ones in Africa are Acacia, Leuceana, Sesbania, pigeon pea.

Use the legumes in your crop rotation, trees you can plant on the side of the field or in between bigger fields. The crop is normally easy to grow and has a growing season around 100 days



Picture 18. proper mulching and intercropping

3.5. Mulching

Leaving crop residues on the soil surface is like using a hat: it conserves the sweat and keeps the head cool

If you cover the soil with organic material you feed the soil slowly but the main reason for mulching is to keep down the weed population and to maintain the micro-environment, especially temperature and evaporation. It helps to conserve the soil moisture and saves water for more critical crop stages. It also provides cover and food for soil organisms and

earthworms. You apply the mulch close to and in between the plants. To get full advantage of the mulch it is best to apply when the soil is warm and moist.

Useful mulch material is for example: wood clippings, grass, old thatching grass, maize stalks, tree leaves.



Picture 19. Crop rotation and intercropping are important with organic farming practices

3.6. Crop rotation

With this method you need to have the field history and your plan. The idea is that on the field there will be a rotation of different crops from different families to help control the pest, diseases and weeds. The aim is that each crop benefits from the previous crop and provides benefit to the following crop in the rotation. Rotations ensure that the same crop will not be grown for a few years on the same ground. Every year or growing season another crop from another family is in succession grown on the same place.

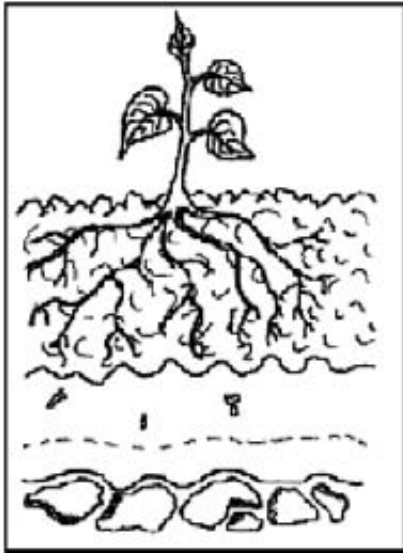
Further crop rotation will relieve the mineral drain on the field. Insect problems will be limited because a balanced cropping system (e.g. a combination of cereal, oilseed, pulse and biennial or perennial legume crops) helps to limit the insect population. It would work the best in a four to five year rotation plan.

The central reason for crop rotation is to improve soil fertility, erosion control and sustained food production.

3.7. Zero Tillage

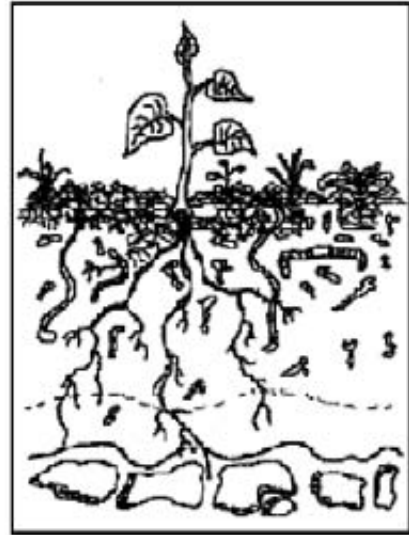
Zero tillage is a method of farming where no soil cultivation is practiced. The farmer makes potholes and plants his crop every year in the same pothole. He adds compost, manure and/or lime to the whole before seeding or planting. In picture 17, you can see the advantages and disadvantages of zero tillage compared with tillage.

To till or not to till?



Advantages of tillage:

- Improves aeration
- Incorporates crop residues
- Facilitates root penetration
- Suppresses weeds



Advantages of zero-tillage:

- Improves soil structure
- Maintains soil organic matter
- Supports soil organisms
- Prevents soil erosion

Picture 20 Advantages and Disadvantages of tillage



Picture 21. Maize planted without soil preparation direct on cover crops.

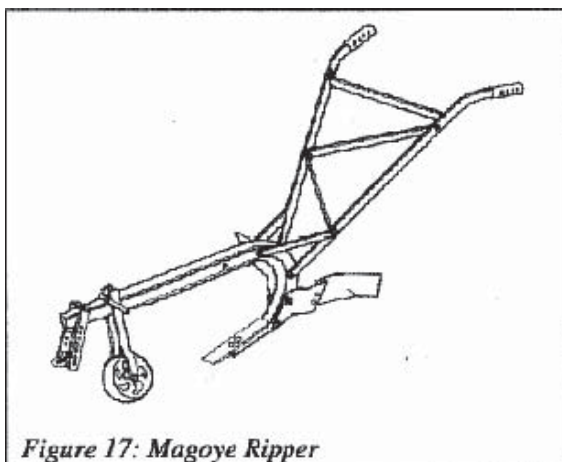


Figure 17: Magoye Ripper

Picture 22. This ripper is used in Zambia for reduced tillage



Picture 23. Direct sowing after the covercrop died, no tillage is done.

4. Management of problems

Pest and diseases are always the worst nightmare for the farmer's crop. With organic farming to spray with synthetic chemicals is not allowed. Luckily there are other methods to prevent and/or reduce the invasion of pest and diseases. Sometimes you can benefit from predatory insects which will help against an invasion of other insects. Low tillage and enough mulch and compost will improve the soil. A healthy soil will give a healthy crop which is more resistant to pest and diseases.

4.1. Pests and diseases in Lemon grass

To date there are in Zambia no pests found which are a problem for lemon grass, apart from goats which will eat it when food is in short supply. Dogs like it when they have a stomach problem. Until now other animals don't like the lemon grass but be aware that there is always a possibility when there is no other food available.



Picture 24. Various insecticides, some can be harmful others undamaging

In other countries the following pests are found:

- White fly – adults very small, white covered with a white meal of powdery wax, winged insects. Often cluster together on the host plant on the underside of the leaf. Nymphs moult 3 times and look like minute yellow scale like dots among the adults. Eggs are oval white laid in a circle. Damage: The nymph sucks the sap and cause yellowing to the leaves. Leaves may dry out and drop off. The flies transmit many viruses to field crops.
- Spotted bug – The bug is about 10 mm have black spots on there shield. The colour of the shield is yellowish, there life cycle takes about 100 days. The eggs are oval white, the nymphs are black and wingless. Damage: The bug sucks the sap from the plants causing wilting and death of the leaves or growing tips.

Diseases or problems found in Zambia are:

- Rust – Red brown colouring spots on the leaves. Effect is a result of dry period and can be caused by bacteria or fungus.
- Purple leaf tops and sides – Due to lack of phosphate.

Found in other countries:

- Smut- Fungal disease, parts of plant covered with blackish powdery spores. Normally this disease is found on grains so probably it will only develop when the grass is shooting.
- Grassy shoot – Fungal disease
- Leaf spot – Fungal disease, black spots mostly at the end of the leaves

4.2. Pest and Disease control in Lemon grass

Schedule 6 Preparation of NEEM solution
(organic insecticide)

Rust is at the moment the major problem in Zambia. It is a minor disease that can be serious some times. Mostly it appears when the plant is weak through drought. If the plant is given frequently water (as advised) it will be healthy enough and the rust might then only appear on older leaves.

Rust is at the moment the major problem in Zambia. It is a minor disease that can be serious some times. Mostly it appears when the plant is weak through drought. If the plant is given frequently water (as advised) it will be healthy enough and the rust might then only appear on older leaves.

Purple leaf tops and sides is a lack of phosphate. This nutrient is normally available in the soil but will be insufficient when lots of crops are harvested without recovering the nutrient balance. Composting, mulching, green manure and rotation will help to minimize the lack but it might be possible that application of Phosphate is needed.

Good Phosphate sources are: bat guano (ancient more than fresh), rabbit and duck manure, pigeon pea can fixate phosphate, pressed grape pulp, steamed bone meal, plume cuts (chicken, ducks), ashes from banana, lemon and cucumber peels, ash from wood (don't mix with manure, this will cause a loss of nitrogen), comfrey tea and rock phosphate.

Yellowing of the leaves could be a lack of N (old leaves, Nitrogen) Mg (mature leaves) or S (young leaves, Sulfur). Lack of sulfur might be due to the fact that the soil is too acid pH under 6. This results in a very little availability of S for the plants. Improvement of the humus in the soil will help to increase the availability of S for the plant.

The lack of N might be due to the fact that the soil is heavily leached and that the crop grows fast with a lack of nutrition.

The lack of Mg colors the leaves white-yellow between the veins. These effects are due to light, acidic, highly leached soils, overload of calcium or potassium.

Whitefly: African marigolds, nasturtium or rhubarb next to the lemon grass will deter the whitefly. Mint and pigeon pea are useful decoy or trap crops.

Phosphate deficiency might weaken the plant and attract the white fly.

If this pest appears in your lemon grass crop then it is useful to use one of the following organic remedies:

- Spray with wood ash mixed with soapy water and/or lime
- Spray with wood ash mixed with lime (allow to stand for 1-2 days)

Repeat these treatments as often as necessary.

Do not use coal ash, don't apply on hot days, don't allow touching the stem

- Dust a fine powdery substance (clay, flour, lime, crushed laterite etc.) onto the leaves the insects or eggs.
- Add powdery substance (especially flour) to water stir until it looks like a thin soup. Let it stand for 5 minutes, pour in other container leaving solids behind. Stir in a little soap and splash it (with a brush, broom) on the lemon grass. Apply preferable during a dry spell.
- Spray with 4 cups flour, half cup sour milk and 20 l water

Repeat these treatments as often as necessary.

Be aware with powdery substances that it might increase surface crusting on soils in poor condition.



Crush 2 handfuls neem kernels or bruise 1 kg neem leaves to make a concentrate



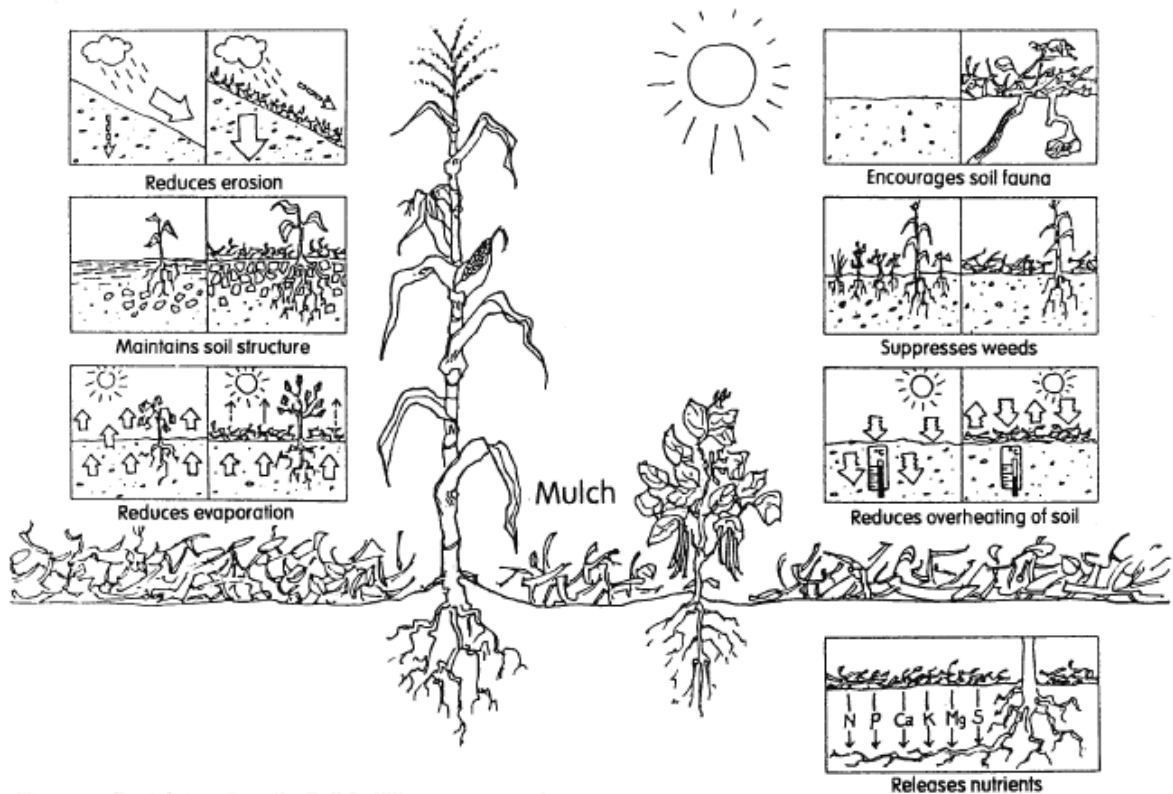
Soak for 15 minutes in boiled water or for a night in cold water



Work under shade, filter concentrate into a half filled tank. (10 lts) Stir in a little soap powder (2 teaspoons) and top up the tank with clear cold water



Spray preferable at the end of the day and not later than 8 hours after preparation of the solution



4.3. Weed control

Weeds can be Harmful but also useful to the crop. If weed control is done under good management hardly any problem will appear and less work has to be done. Weeding in the first two weeks after planting will ease the work because the roots of the weeds are still small. The best time to weed is just after sunrise when the soil is still a bit wet from the dew.

Weed before the weeds set seeds, preferably as soon as they emerge. Leave the weed residues as mulch in between the plants.

Mulch and Green manure will suppress and reduce weeds.

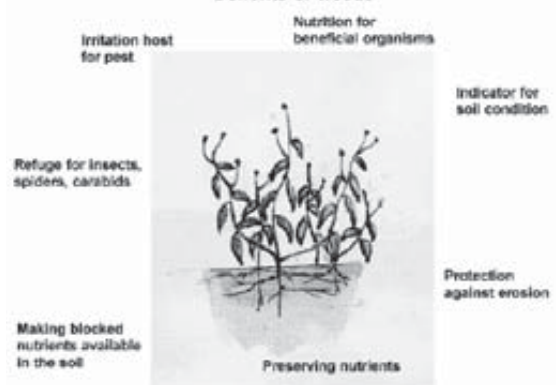
Weeds can be used as soil indicators (e.g. clover (lack of N), useful organic controller (e.g. lantana as organic insecticides)

Preventive crop protection measures

- 1) Adapted and resistant varieties
- 2) Clean seeds and planting material
- 3) Suitable cropping systems
- 4) Balanced nutrient management
- 5) Input of organic matter
- 6) Appropriate soil cultivation
- 7) Good water management
- 8) Promote natural enemies
- 9) Optimal planting time
- 10) Sanitation measures

Picture 26. To get the best out of your plant think about the above measures

Benefits of weeds



Picture 27. why weeds can have a positive input in the field

5. Agro forestry

Within the lemon grass production, agro forestry is an important factor. When lemon grass is processed into oil wood is needed as a source of fuel for the distillation. Fuel for distillation in Zambia is at the moment still wood. The combination of agriculture and forest management is called agro forestry. Trees can have direct and indirect benefits for the farmer.

5.1. Benefits

Direct: These seems to be in the first place the most important ones because these trees provide the important and obvious benefits such as food, medicines, timber, fuel, manure and shade.

Indirect: Although these effects are not seen immediately they are at least or even more important as the direct benefits. It all has to do with the improvement of the ecosystem. Water and nutrient cycling, soil improvement, erosion control, biodiversity, carbon sequestration, habitat for predators and wind break are the most important improvements which occur through combining forestry and agriculture.



Picture 28 Trees and agriculture are growing together in the field

5.2. How to combine

Trees have the opportunity to bring up the nutrients from deep down via their root system. The roots of crops are normally not deep enough to reach there so if the leaves or branches are used as manure the tree can provide the crop with nutrients from deep down and is not competing with it.

It is important to know if the crop is shade tolerant, needs shade or can't grow under shady circumstances. Lemon grass can stand shade as long as it is not totally under shade the whole day long and the sun is filtered through the trees. This gives the opportunity to plant trees on the outside of the lemon grass fields or even in between. It is also possible to leave the trees which are already in the field and provide from them, sometimes this gives a chaotic reality in the field but it might improve the production after all.



Picture 29. Lay out of agroforestry homestead

5.3. Agroforestry management

The tree seedlings can be made before the rains in the nursery.

They should stay in the shade (under a tree, a shelter made from sticks and banana leaves, etc.). Take the trees two weeks before planting out of the shade to get used to sun. Water the plants well one day before planting them out in the field.

If water is available all year round, trees can be transplanted in the field when they are big enough (about three months) and the sky is cloudy. If the farm is rain-fed then it is better to wait before the rains are established.

Planting holes should be made at least two weeks before you transplant and the plot must be weed free. Add some compost and cover it with soil. Wood-ash can also be added as a treatment against termites. The hole should be as deep as the container is high and wider than its diameter. Make a small basin to help to maintain the supplied water.

Cover the soil with some mulch. Protect the seedling against animals by surrounding it with a natural fence. Water should be applied at least once a week.

When the trees are mature pruning is needed to manage the light competition.

Planning of the activities and time involved within the forestry sector is critical to avoid competition with the food-crops. Make sure that there is time reserved for the trees even if you are busy with maize. Plan this into the cropping plan.



Picture 30. example of a agroforestry main field



Picture 31. When the trees are cut higher above the ground the browsing for animals is restricted

5.4. Which trees

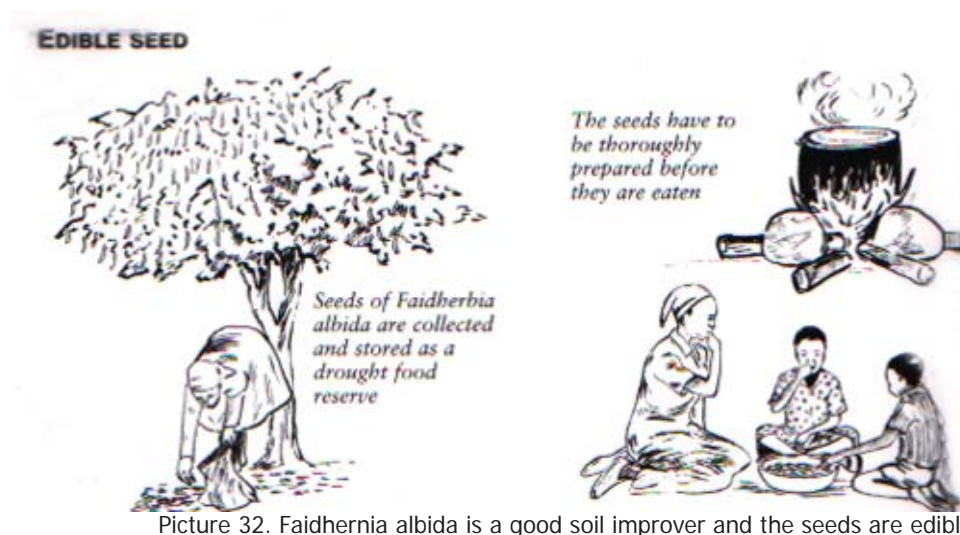
Firewood: Sesbania, Malina, Musangu (*Faidherbia albida*), *Gliricidia sepium*, *Flemingia Macrophylla*

Nutritious: *Leuceana*,

Pest management: *Ububa* (*tephrosia vogellii*), Chinaberry, *Senna siamea*, Blue gum, Neem

Food: All fruit trees, leaves and flowers of *Sesbania*, new shoots, leaves and fruits of *Leuceana*, leaves, fruits and flowers of *Moringa oleifera*.

Cash crop: Fruit trees, Nut trees, oil from seed of *Moringa oleifera*, Musikilli, Baobab, *Jathropha*, Manketti



Picture 32. *Faidherbia albida* is a good soil improver and the seeds are edible

6. Harvesting and processing

Harvesting and processing of the product are as much as important as the growing even in this stage a product loss can occur because of wrong handling and processing.

6.1. Hygiene

As the final products are for food consumption, a high level of Hygiene is very important throughout the harvesting and processing. Contaminated crops may mean that the whole consignment has to be rejected. Don't spray a compost tea or any organic pest controller on the plants three weeks before harvesting. Make sure all hand tools are cleaned with soap and water. Your cart or other means of transportation must be wiped and cleaned. Make sure that animals can't get in the lemon grass. The fresh material must be taken to a central handling facility for further processing.

6.2. Harvesting

The grass can be harvested at a length of 50 cm for both distilling and drying. If cut in time, it is possible to have three harvests during the rain season (1st before rain, 2nd in January, 3rd in April). First grade grass can go to the dryer. This grass should be free from any spots or browning on the sides. The first grading can take place at the same time as you harvest, leaving the residue in the field for mulch. The second grading is done at the central handling facility.



For the dry grass, you can harvest the grass at the same time as the grass for the oil or you harvest the grass before the grass of the oil but then grading has to take place at the same time as you harvest. Advantage might be that the work load is spread over a period of time and not coming in once. The disadvantage is that it consumes a lot of time as one cut the grass more precisely. Cutting of the grass can be done with a sickle knife, – which must be sharp so as not to damage the end of the grass, more precise work might need a smaller knife.

6.3. Processing

After the product is harvested, it can be processed in two ways; drying or distilling.

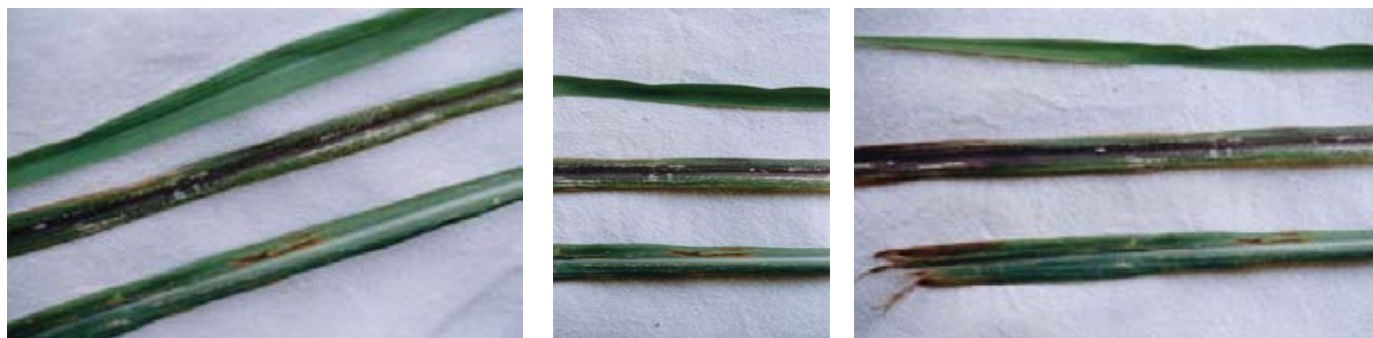
When the final product is dry lemon grass for tea, you have to sort again, the good undamaged leaves go to the dryer, the less qualified leaves are going to the distiller or will be used as mulch. After this is done, the leaves for the tea will be laid flat on the racks in a thin layer and within 48 hours they should be dry in the rainy season this might take a week, you have to turn the product during drying. After the drying, the leaves have to be tied with a lemongrass leaf, in a ± 10 cm diameter bundle.

All the lemon grass which can't be used for tea can be used for distilling. The grass for distilling need to be dried for about two days in the dry season, in the raining season it is better to distill it straight away because of the risk of mould. If the still is not close by it is necessary to dry the grass proper because of the transport and the packaging time. It is the responsibility of the farmer to keep the quality of the product until it is bought by the buying company.

When grass is packed in bags after it is dried the storage place should be dry and clean. It is good to check the bags every second day for mould during the storage time. Bags should be well marked with name, farmers' nr, date of packaging and kg.



Schedule 7. Rub hands and wrists for 30 seconds then rinse and dry thoroughly



Picture 33. How lemon grass should look like for tea production is shown by leave no 1 in the pictures. No 2 and 3 show rust and drought problems this grass is only good for oil production



Picture 34. A small distilling unit for the processing of plant particles to obtain essential oil..



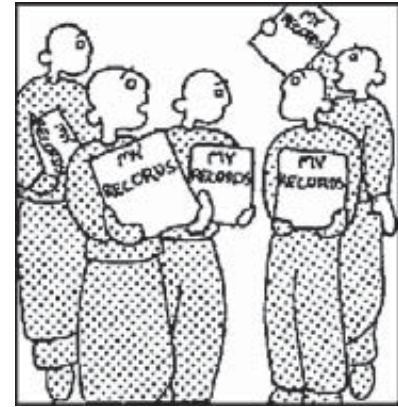
Picture 35. Washing hands before they are getting in contact with the grass



Picture 36. Washing and cleaning the cart. Make sure the ox is not dropping manure on the grass



Picture 37. Washing of the tools used in lemon grass is very important before it is getting in contact with the grass



Picture 38. You can compare records with other farmers

SAMPLE OF FARMER'S OWN RECORDS

1989 FARM RECORD	CONTROL PLOT	TEST PLOT
PREPARING GROUND 		
PLANTING 		
WEEDING 		
HARVESTING 		

Picture 39. Sample of farmers own records. Everytime the farmer spends half a day on a plot he draws a line in the table.

7. Record keeping

Keeping track of activities and its results is very important when you run a commercial business. It might guide you through the agricultural year so that earlier response to agricultural problems, financial situations, labour pressure as well as planning of activities and field schedules can be adequately approached. In this chapter a look at possible record keeping is described.

First it is good to organize a good map of the farm. Ask the field officer for help if it is problematic to draw a map by yourself.

Make the cropping plan and a year plan.

Make for every field a small file where to keep records of all the activities which happened on the field. If written words might give problems for the ones who are working on the field, then use pictures to indicate the actions. Keep records of all the actions, from planting, weeding applications and harvests. A table is very useful to work with. An example of a table is shown below. If literacy is low, drawings can be substituted for writing, and pencil strokes for measures, where time spent working in various activities was recorded. By making one mark for every half-day spent doing specific jobs, a farmer can compare the time worked on a plot.




Picture 40. some easy drawings

- Sowing
- planting
- weeding
- harvesting
- irrigating/ raining



Picture 41. You can always ask your field officer to assist you with record keeping.

Table 4. A sample of a cropping plan.

	Date	Quantity	Man hours	Specific activities like (plant spacing, type of application, way of harvesting /weeding)
Planting/sowing				
Weeding				
Application				
Watering				
Harvest				

Besides these records per field it is advisable to keep records for composting, labour costs, soil management, income per crop, problems observed, the losses and other costs.

It will help to

- Judge whether activities (new species, irrigation, etc.) are beneficial
- Test and compare old practices with new practices
- Provide an “early warning system”
- Provide records to keep your time, money, input output, etc organised



8. How to use lemon grass

Lemon grass can be used as a mosquito repellent, tea, and in culinary dishes.

Picture 42. Lemon grass stems in syrup with ginger.

It is very important that you don't drink lemon grass tea every day because this may cause harmful effects on the human health but as a medicinal it is very good to use.

Lemon grass leaves made into a paste with buttermilk can be applied for ringworm. A decoction of the leaves can be locally applied on rheumatic joints and sprains.



Picture 43. Lemon grass leaves used in herbal tea.

Tea from the leaves with black pepper is used in congestion and disordered menstruation

As a mosquito repellent, it might be useful to have some plants around the house especially where the entrance or the windows are

In a culinary dish, you can use a stalk of the plant and pound it as garlic. The dish will get a lemon flavor. Remove the stalk before serving the food.



Picture 44. Some cosmetic products with lemon grass oil



Picture 45. Scented candles with lemon grass oil



Picture 46. Lemon grass stems used in food preparation

9. Acknowledgements

This manual is prepared by AgriOrbis – AgroEco to serve as a tool to assist the small scale farmer with background information about growing lemon grass as an organic cash crop in Zambia.

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Information has been drawn from a number of sources in preparing this field manual. The following documents were used extensively:

TLC Malawi (2002). Field manual for treadle pump irrigation in Malawi. Publication No. 1.

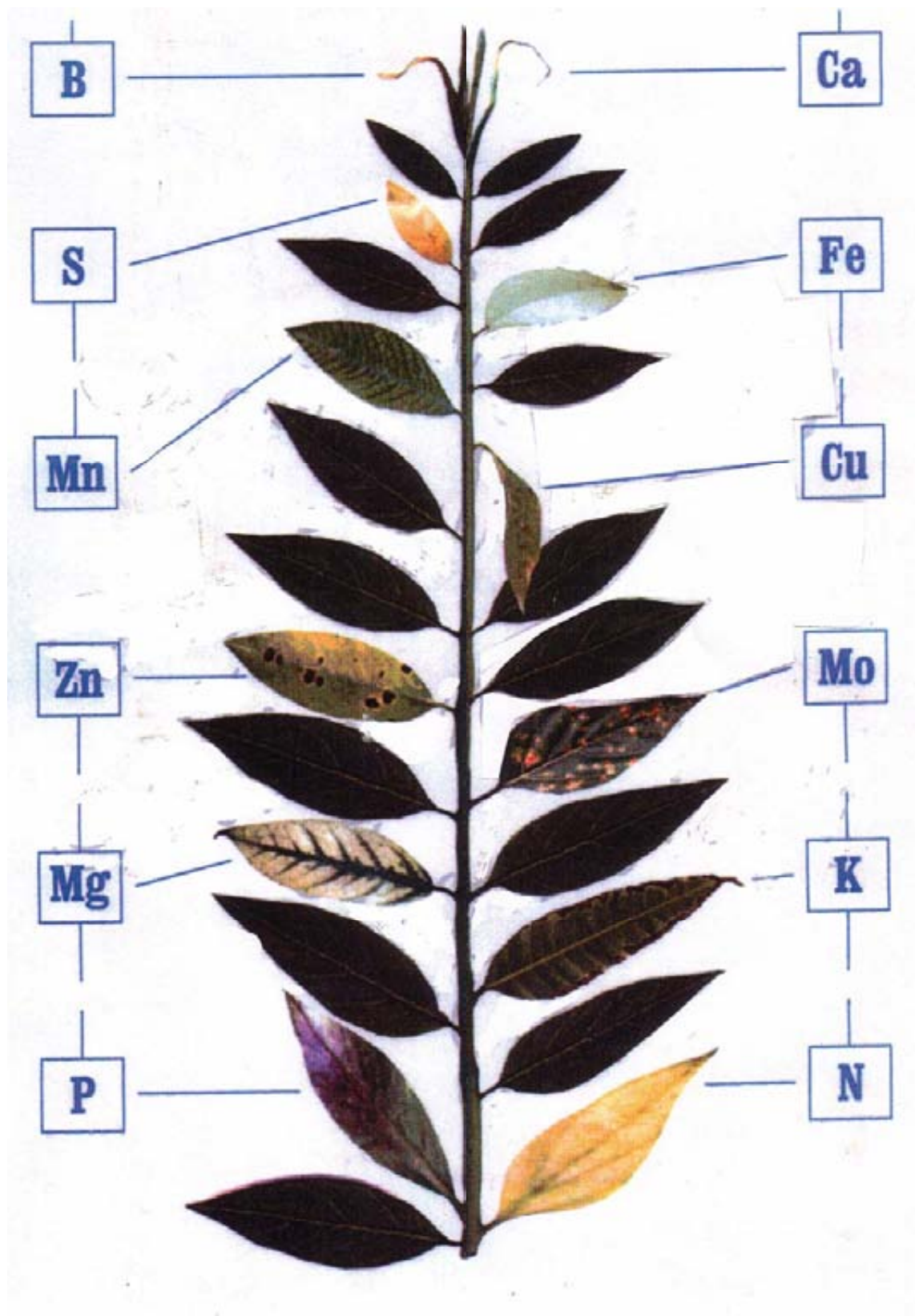
H. Elwell & A Maas (1995). Natural pest and disease control. Harare Zimbabwe

F Eyhorn, M Heeb & G. Weidmann (2002). Ifoam training manual for organic farming. Germany.

The author is responsible for the views expressed in this manual, Which may not necessarily conform with the funding agency.

The initial technical draft was prepared by Carianne de Boer of AgriOrbis under contract to the EPOPA programme. Subsequent additions, editing and layout where done by project leaders from EPOPA, field supervisors, field officers and farmers.

Special thanks are due to all the people who contributed their knowledge and experience.



Picture 47. Characteristically symptoms the plant shows you when the plant has a deficiency of a specific nutrient..

- On the terminal leaves you can see deficiency of Ca and B
- On the leaves you can get the symptoms if the plant has a deficiency off K, P, N, Zn, Mo or Mg
- On the new leaves you can get specific symptoms when there is a deficiency of Cu, S, Fe or Mn

Check schedule 3 if there is a deficiency because of problems with the acidity in your soil

10. Lemon Grass Hand book

Lemon grass (*Cymbopogon citrates*), is one of the species that one can use for commercial production is a tropical grass type originally from India. It derives its name from its strong fresh lemon scent. In Africa, it is quite often used as an ornamental plant. It is a tufted perennial grass with numerous stiff leafy stems arising from short rhizomatous roots. The leaves can grow up to a height of 2m. It is a perennial crop and has an economic lifespan for about 5 years

In this handbook, different ways to work with lemon grass in the field are described. It is a guideline for farmers to grow lemon grass but some information can also be used as a guideline for other crops.

Lemon grass is an easy growing crop. It is very suitable for a small scale farmer as a cash crop. Hardly any diseases or pests are found in Lemon grass which makes it a suitable crop for crop rotations and inter cropping with other crops. Lemon grass can be grown from seed or from division of the pruned rhizomes (which is normally the case).

A healthy plant comes with a healthy soil. A healthy soil can restore more water with a higher amount of nutrients. Adding compost or compost teas will improve a numerous of factors which are influencing the yield of the crop. Mulching is another technique that can influence the yield positively. Advantage of mulch is also the reduction of weeds, because they need light to develop, and better water house holding.

In Zambia the used parts for production are the leaves. Leaves without any spots or browning can be used for the tea industry. The other leaves can be used to distill oil.

TALK , PLAN and PREPARE upfront, during and after

This manual is produced by EPOPA Zambia



Development through organic trade

Since the early 1960s there has been a growing market in Europe, Japan and the USA for products grown in a sustainable manner and without the use of agro chemicals. The organic market has grown from US\$ 13 billion in 1998 to US\$ 30 billion in 2007. This is due to the increasing environmental concerns by the consumers in these developed countries. As such, they are willing to pay premium prices for certified organic products. Slowly but surely, governments, as well as development cooperatives, are recognising the contributions that organic agriculture can make to environmental, health, bio-diversity and food security issues.

The aforementioned situation made for a good opportunity for African countries to find premium export markets. Thus, the EPOPA programme – Export Promotion of Organic Products from Africa – was birthed by Sida in 1997.

The first two phases of EPOPA-programme from 1997-2001 and from 2002-2004 proved to be successful. In total more than 100,000 smallholders in Tanzania, Uganda and Zambia have participated. It is encouraging to note that the first two projects initiated by EPOPA, involving 30,000 farmers, are self-sustaining to this day.

The price that the farmers receive for their cash crops is 15 to 40 percent higher. Many farmers report a significant increase in productivity due to more intensive crop management measures. The farmers also produce their own food organically.

The farmers also appreciate the extra attention given to them by the extension workers and generally respond to that by caring more about farming.

The higher prices are not achieved by the organic qualification only but also by better quality products and in some cases, by more direct trading structures. In one project, the exporter is also on the fair trade coffee register. These three aspects together resulted in a 50 to 100 percent increase in income.

Read more about EPOPA at: www.epopa.info



EXPORT PROMOTION OF
ORGANIC PRODUCTS FROM AFRICA