

## Pest and disease control and crop rotation

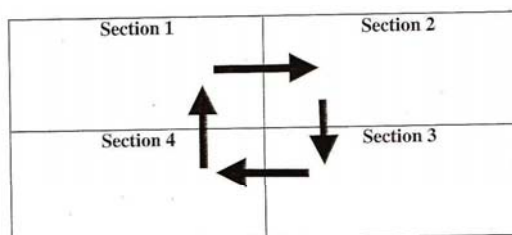
### **Pest and disease control**

Pests and diseases can reduce yields and the quality of the crops. Chemical pesticides can be used but they are expensive and dangerous. Alternative methods include:

- Using certified seeds
- Following recommended practices (fertilisation, weeding and irrigation)
- Crop rotation
- Isolating the cropping area from the surrounding vegetation with a wide/clean strip of land.
- Regular scouting of crop fields for pests and diseases to allow early intervention.
- Using *Tephrosia vogelli* as an organic pesticide.
- Intercropping: some pests can be avoided by planting different vegetables on a planting bed. *Example:* onions or garlic planted around tomato reduce the danger of bed spider mite.

### **Crop rotation**

Crop rotation is the alternating of different crops each season. This reduces build up of pests and diseases common to a particular crop family and helps maintain soil fertility.



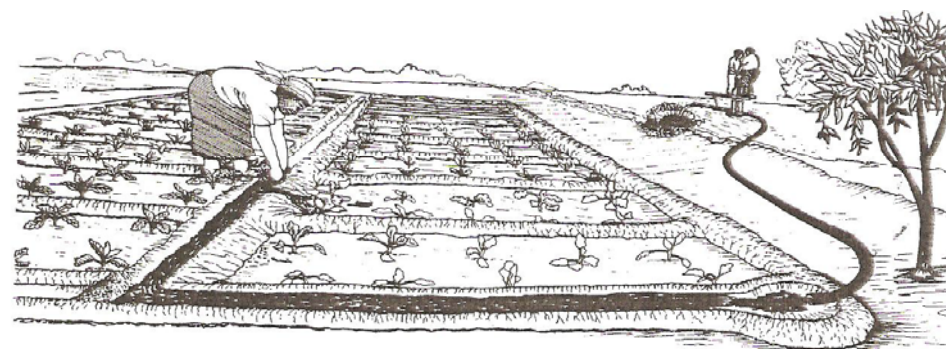
*Sample rotational plan:*

Section 1: Solanaceae - tomato, eggplant, green pepper  
Section 2: Cruciferous - drumhead cabbage, chinese leaf  
Section 3: Root/bulb crops and legumes - onions, garlic, carrots and beans  
Section 4: Cucurbit and Cereals - cucumber, watermelons, maize



## ***Small Scale Irrigation***

ENGLISH



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## INTRODUCTION

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### **What is irrigation?**

In dry area and/or in dry period, the moisture of the soil may not be enough to cultivate crops.

In those cases, water can be artificially provided to the fields to maintain moisture in the soil for cultivation: this is irrigation.



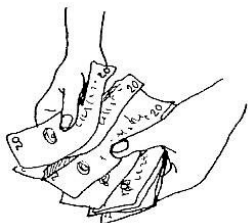
The supply of water on the plot can be done thanks to watering cans, treadle pump, channels... depending on the access to water and on the settings of the site.

During the dry season, the irrigation is the only way to have crop production. It increases the intensity of cropping, so it raises the productivity of farmland.

This allow farmers to reach three main objectives:

☞ To fight hunger

☞ To improve the diet through the production of vegetables



☞ To increase incomes and to improve the livelihoods by selling the surplus

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## **Weeding and fertilisation**

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### **Weeding**

Keep crops weed-free. Competition from weeds for nutrients and light will reduce yields.

Suckering (or pruning) involves the removal of excess shoots from the plant to encourage better fruit size and quality. It is particularly recommended for maize and tomato.

### **Fertilisation**

A combination of organic and inorganic fertilizers can be used. Remember that organic manure can improve the efficiency of inorganic fertiliser and therefore reduce the quantity required.

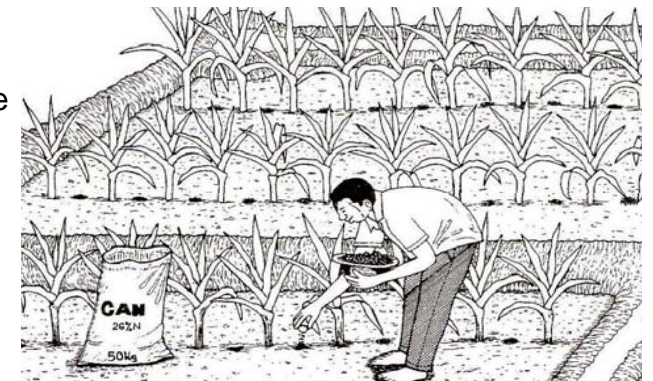
Use of organic manure: Mix 2 buckets of compost/manure into every basin before planting. Agroforestry alternatives are also encouraged (*Tephrosia vogelli*, *Glyricidia sepium*, *Fedherbia albida*...).

### Use of inorganic fertiliser:

Use D-Compound (or 23/21/0+4S) for the basal dressing. Apply it 3-4 days after transplanting or just after emergence for direct sown seed.



Use CAN for the top dressing. It should be applied first 3 weeks after planting/transplanting, and then 2 weeks later.



## Irrigation

### Irrigation frequencies

This table is an approximate guide. The best guide is always to feel the soil and examine the crop.

Time of planting/ transplanting	Crop type	Growth stage*	Irrigation interval (days)
Cool dry season (April - July)	Sensitive vegetables (onion, pepper)	Initial	3
		Development	4-5
		Mid to late season	3-4
	Tolerant vegetables (tomato, cabbage, rape)	Initial	4-5
		Development	7-8
		Mid to late season	7
	Green maize	Initial	6-8
		Development	9-11
		Mid to late season	6-8
Hot dry season (August - November)	Sensitive vegetables (onion, pepper)	Initial	2-3
		Development	3-4
		Mid to late season	3
	Tolerant vegetables (tomato, cabbage, rape)	Initial	4-5
		Development	5
		Mid to late season	4
	Green maize	Initial	5-7
		Development	5-7
		Mid to late season	4-6

\*The development stages correspond to:

*Initial*: germination and early growth;

*Development*: up to the time when the crop achieves full ground cover;

*Mid to late season*: from flowering to full maturity.

## How to plan the production?

If farmers don't plan well the production, all their products may come on the market at the same time as the other farmers and they will have problems to sell it (losses, low prices...).

Therefore, before starting the production activity, the farmers should think carefully about what to grow and when to start.

### What to grow?

The choice of the crops to grow will depend on what the farmers want to eat and what they want to sell.

For the crops that they want to sell, farmers should consider the possibilities of marketing:

- Which market can they reach with their own means of transport ?
- In each market, which crop will find a good demand (enough customers)?
- In each market, which crop can be sold at a good price (*for example, if everybody sells tomato, the price is low and it can be advisable to choose another crop*)?

### When to start?

The farmers should think about the best time to sell the crops in order to determine the best time to start sowing the seeds.

Concerning vegetables, farmers should be careful : if they sow all the vegetables at the same time, they will harvest everything at the same time and may have problems to sell their production. Therefore, it is better to sow the seeds little by little in order to get some production all along the cropping period.

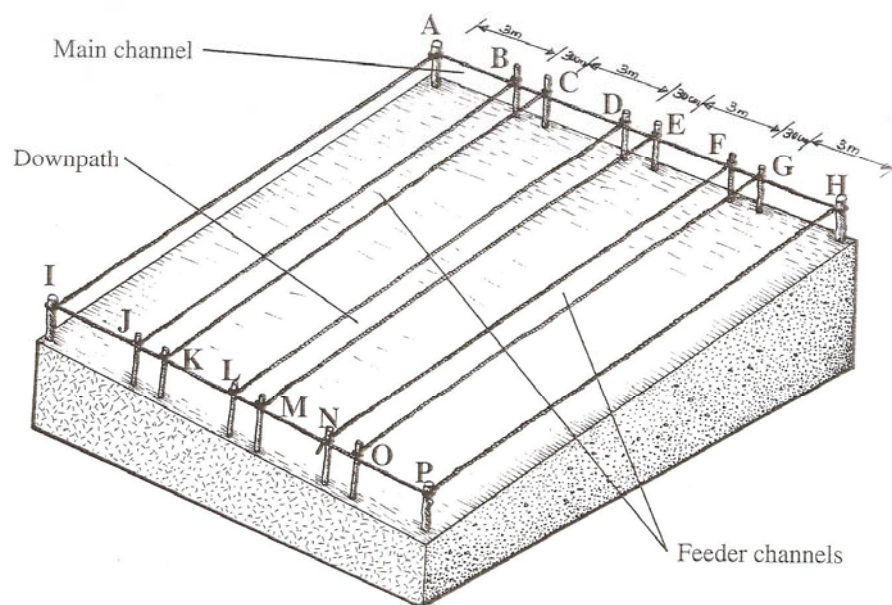
Having 2 cycles of production, where water is available, allows to produce more and can also assist to get better prices.

## PLOT LAY OUT

The plot lay out should be prepared well in advance before planting, according to the following steps:

### *Construction of the main and the feeder channels*

1- Mark the main and feeder channel, with pegs and a local string. The channels should be 30cm wide, with a 3m space between them.



2- Construct a ridge for the main channel about 30cm high, centered on the string.



## Irrigation

### *c) Crop type and characteristics*

The amount and timing of irrigation depend on several criteria:

Crop development: As the crop develops, its water demand increases. Therefore, the crop needs to be irrigated more frequently but with less water during the early stages and less frequently but with more water as it develops.

Growth stages: During critical stages, water shortages can highly damage the yields.

It is crucial to ensure that adequate irrigation is provided at these times.

Crops	Critical stages
Cabbage	Head enlargement and ripening
Maize	Flowering and grain filling
Onions	During rapid bulb growth
Potato	Start of potato formation, early vegetative period and ripening
Tomato	From flowering to harvest

### *d) Close and frequent examination by the farmer*

The better option is for the farmer to examine the crop and the soil to adapt well the amount of water to be applied.

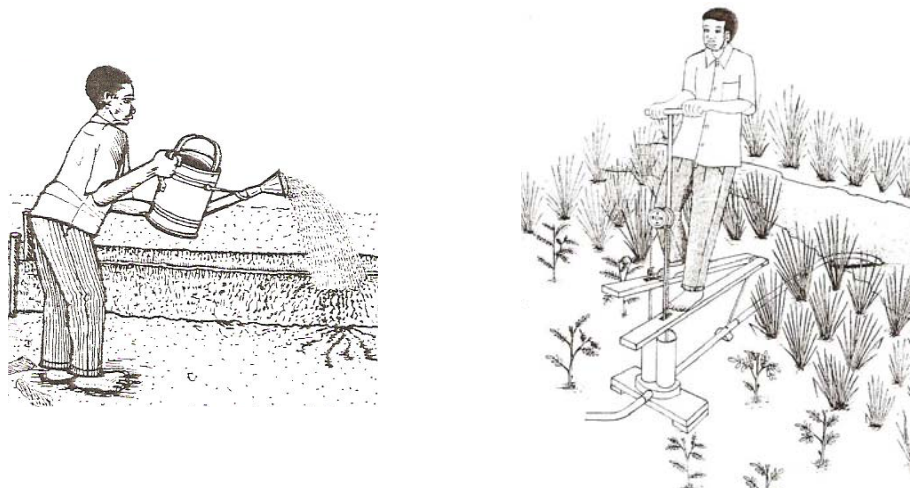
- Crop appearance: If the leaves are discoloured (greyish green) or wilted in early morning or late evening, this is a good indication that the plant needs water.
- Feel of soil: Take a sample from a suitable depth (not simply from the surface). Except for very sandy soil, if the soil can not be moulded into even a weak ball, then irrigation should be given.
- Rainfall: Examine the depth of water penetration one day after the rainfall; if no significant wetting depth is found, irrigation should continue as normal.

## ***Irrigation***

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The objective of irrigation is to supply the required amount of water to the plants, for optimum growth.

### ***How to determine the quantity of water to apply?***



#### ***a) Soil characteristics***

The type of soil determines how fast water moves through the soil and the amount of water that can be made available for the plant.

Water moves faster through sandy soils but the water storage capacity is lower than for clay soils. Therefore, sandy soils require less water but more frequent irrigation than clay soils.

#### ***b) Weather conditions***

Crops require less irrigation in the cool dry season than during the hot dry season.

The norm for most crops is to irrigate:

- Every 5-7 days during the cool dry season (April – July)
- Every 3-5 days during the hot dry season (August – December)

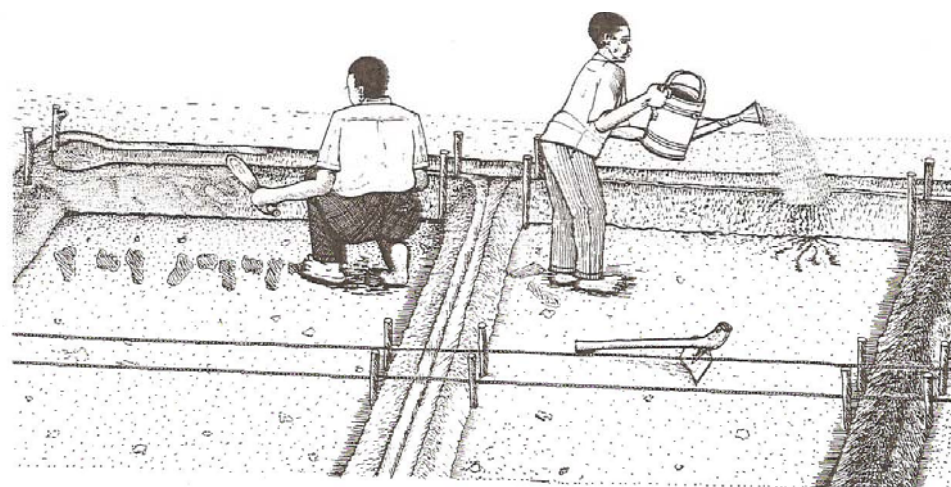
## ***Construction of the main and the feeder channels***

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3- Form a channel on the top of the ridge. If no treadle pump will be used, simply construct an uncompacted ridge without a channel.

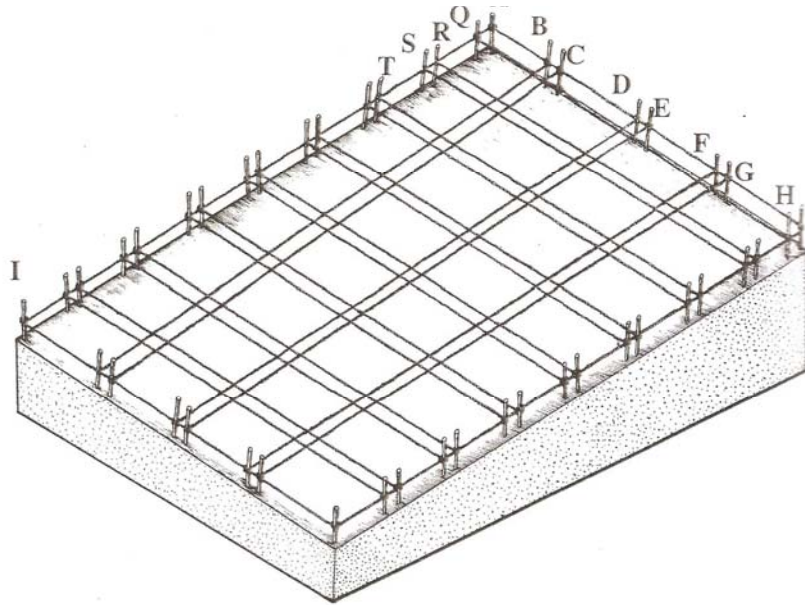


4- Water and compact the main channel

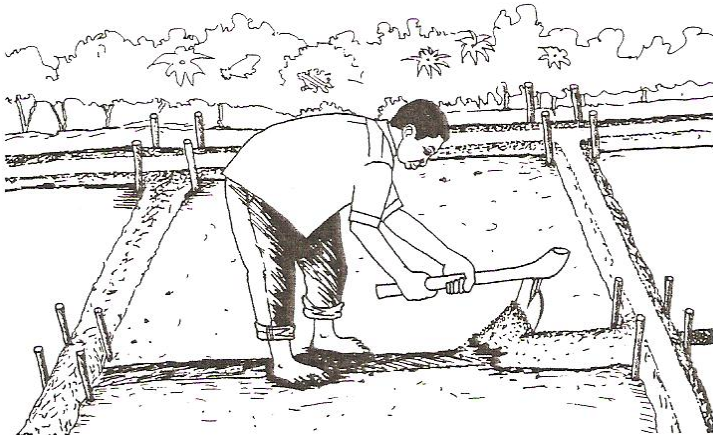


## Construction of the basins

5- Basin marking layout, with pegs and a string. The basins should be 3m long x 1.2 wide with a space of 30cm between them for the ridges.



6- Basin construction: make the ridges with a hoe. Then, add 2 pails of manure and till the basin to a depth of 30cm.



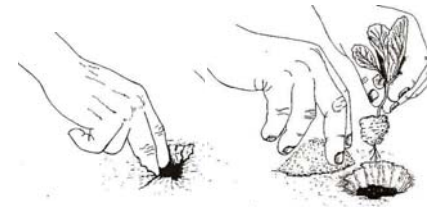
## Planting

### Transplanting seedlings

1. Transplant seedlings early in the morning or late afternoon to reduce evapo-transpiration. Water the nursery bed one hour before transplanting.

2. Lift the seedlings one by one with its roots covered with soil.

3. Transport the seedlings in a bucket, basket or bowl to the planting site. Separate carefully any seedlings joined together by the roots.



4. Make a hole 3-4 cm deep at the marked position. Then carefully place the seedling in the planting hole with the roots pointing down.

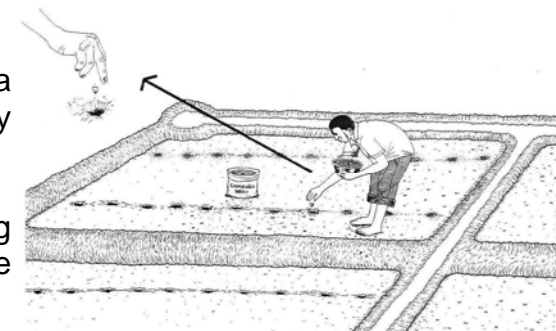
5. Press the soil firmly around the root collar of the seedling with the fingers to keep it upright and to expel all trapped air.



### Direct sowing

Some crops such as maize, okra and Irish potato can be directly sown into the planting beds.

Make holes at the marked planting stations, place the seeds in the holes and cover it with soil.



# CROP MANAGEMENT

## Basin preparation and crop spacing

### Planting bed preparation

Undertake the following before planting crops in the basins:

- Add 2 buckets of manure or compost to each basin and till to a depth of 30 cm
- Ensure that the basins are leveled
- Irrigate the basins one hour before planting

### Recommended spacing

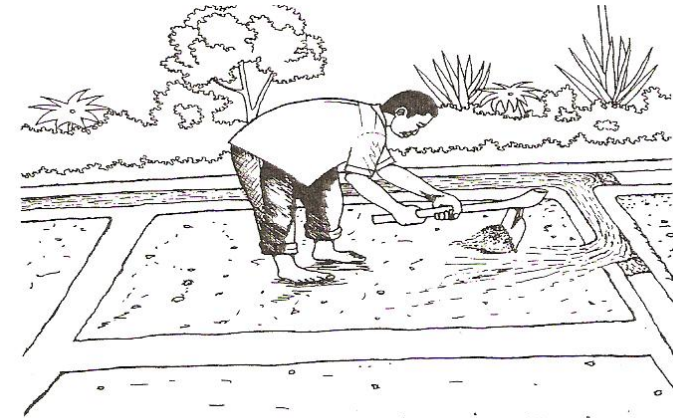
	Row spacing	Plant spacing
<b>Tomato</b>	90cm (3 feet)	60cm (2 feet)
<b>Cabbage</b>	70cm (2.5 feet)	60cm (2 feet)
<b>Okra*</b>	90cm (3 feet)	45cm (1.5 feet)
<b>Onions</b>	30cm (1 foot)	10cm (4 inches)
<b>Mustard</b>	45cm (1.5 feet)	45cm (1.5 feet)
<b>Rape</b>	45cm (1.5 feet)	45cm (1.5 feet)
<b>Eggplants</b>	90cm (3 feet)	75cm (2.5 feet)
<b>Irish potato</b>	20cm (8 inches)	30-40cm (1 foot)
<b>Hybrid maize*</b>	75cm	25cm

\* Direct sowing: Okra (2 seeds per planting station, 2.5 cm deep)  
Maize (1 seed per planting station, 3-5 cm deep)

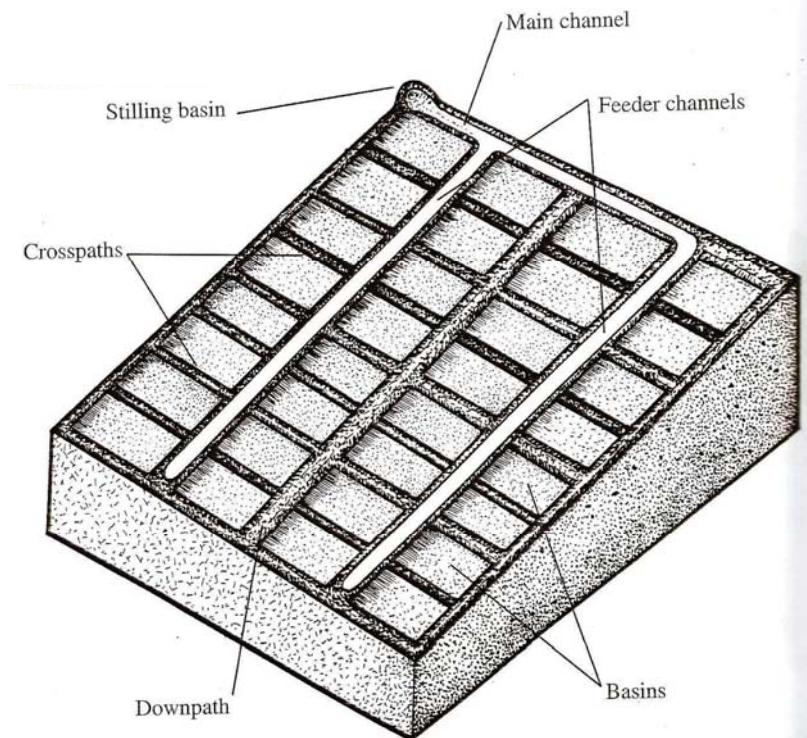
Mark out the correct spacing before planting, using measuring sticks and pegs.

## Construction of the basins

7- Level the basins, using water as a guide.



8- Completed plot lay out



## *Irrigation of the plot with a treadle pump*

1- Farmer A fills the cylinder with water and kinks the delivery hose.

Farmer B holds the end of the suction hose up until it is full and checks that no bubble of air is trapped.

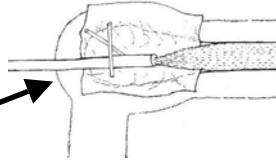


2- Farmer B drop the suction hose into the water.

Farmer A unkinks the delivery hose and starts treading the pump.



3- Run the delivery hose from the pump to the stilling basin. Secure the end of the hose with sticks to ensure that it does not leap out.

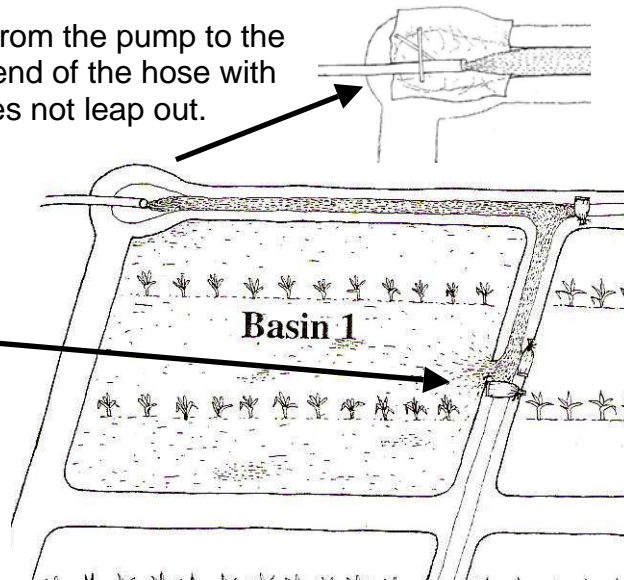


4- Fill small plastic bags with soil to serve as dams for blocking channels and diverting water.

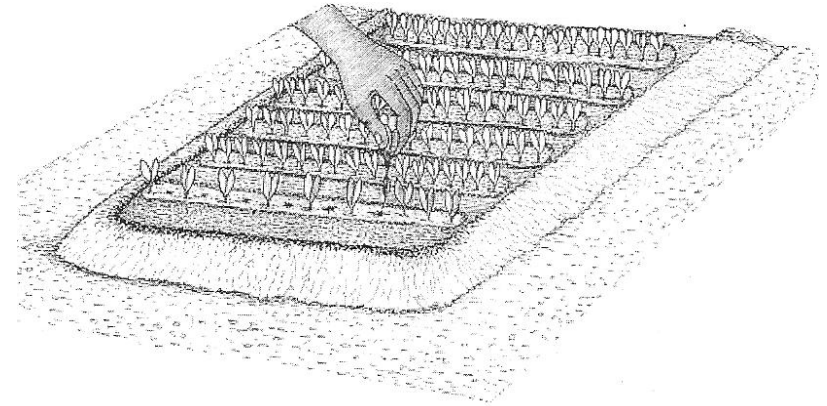


Fill one basin at a time.

When one basin is filled, change the position of the plastic



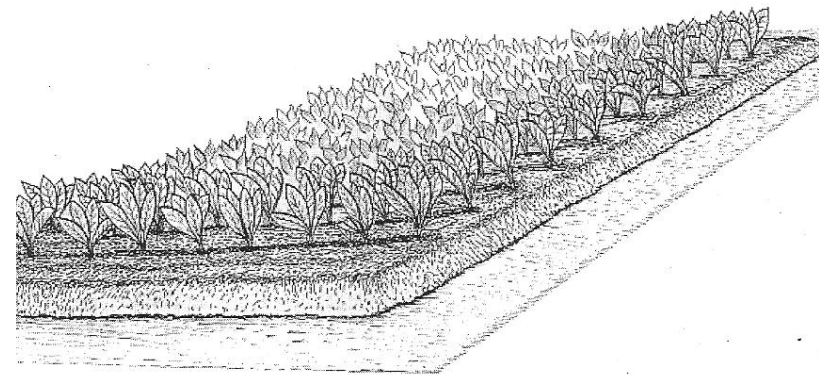
## *Weeding, thinning, hardenning-off*



7- Continue watering twice a day.

Remove the shade after 2 weeks and water once a day.

Thinout the seedlings on the nursery bed, leaving some at 6cm apart. Make sure that the nursery is weed-free.



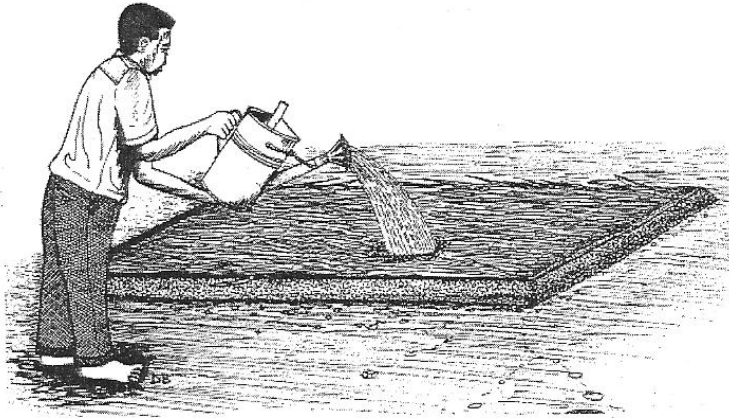
8- Outplant the seedlings when they are 10-15cm high.

Reduce the amount of watering a week before outplanting.

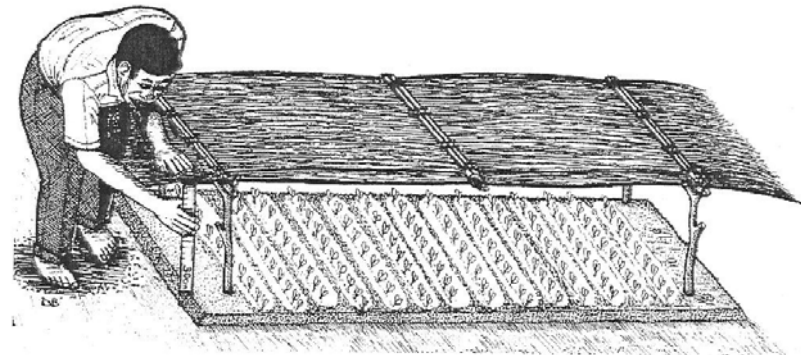


## *Watering and shading*

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5- Continue watering twice every day.

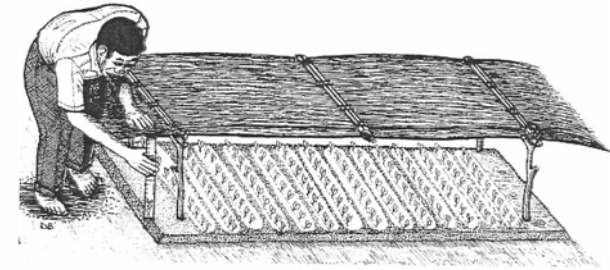


6- Remove the mulch from the seedbed when the seedlings emerge and make a shade 30cm high.

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## **NURSERY MANAGEMENT**

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Nurseries provide ideal conditions to raise strong, healthy plants that grow well after transplanting, because a large number of plants can be easily managed in a small, fertile, well-protected area.

The following crops should be sown in a nursery: tomato, onion, eggplant, cabbage, mustard, rape...

### *Site selection*

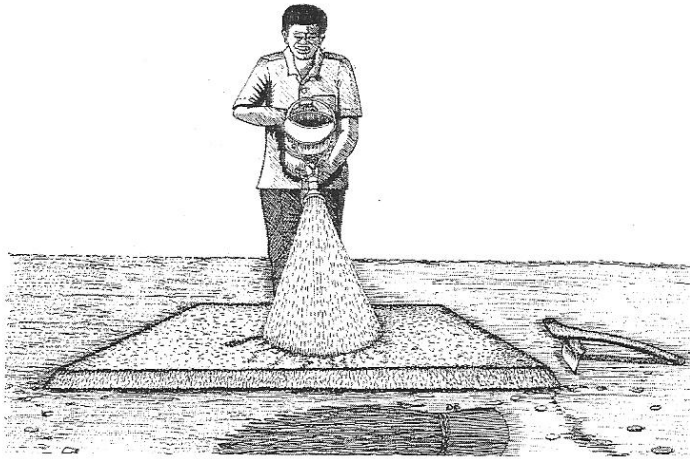
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A good nursery site should be:

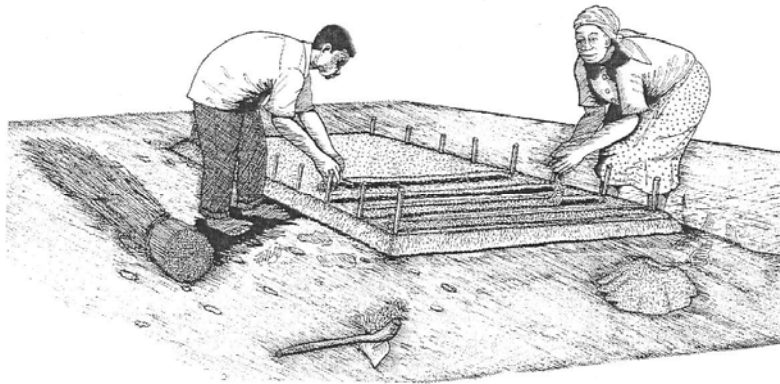
- on flat land to avoid soil erosion
- not shaded by trees
- close to a water source as the plants will need frequent irrigation with a watering can
- favoured with well-drained, fertile soil
- protected from livestock

## Seed bed preparation

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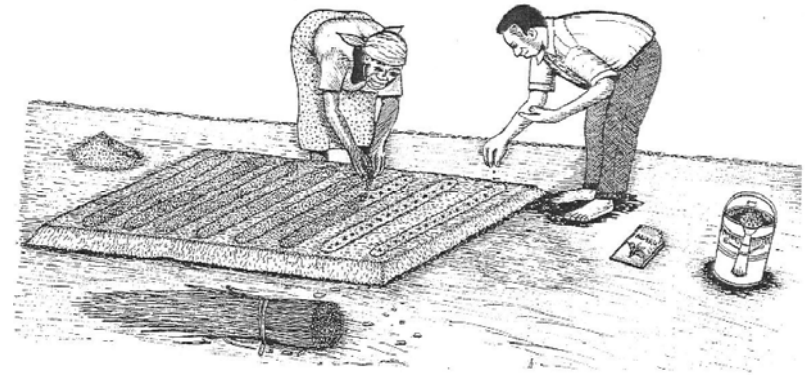
1- Construct the bed 20cm high, 1m wide and 3-4m long. Water the bed thoroughly and wait for 1 hour before sowing the seeds.



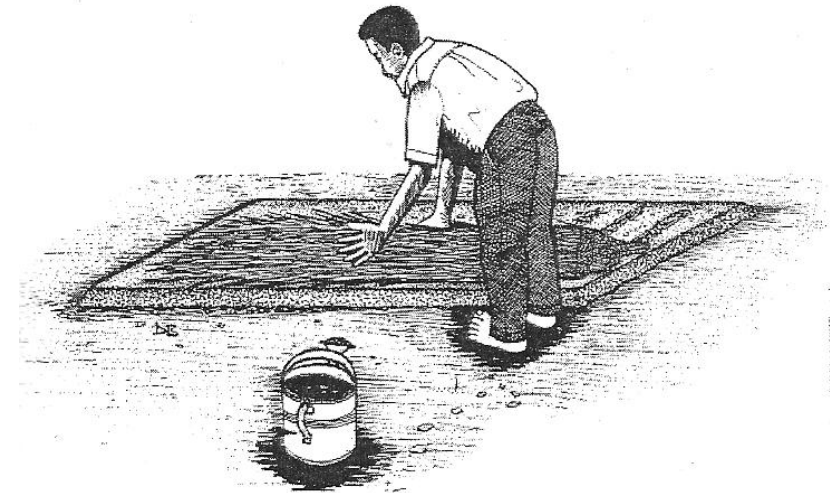
2- Drill 0.5 cm deep rows 20 cm apart and line with sand.

## Sowing and mulching

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3- Sow individual seeds along the drills at 3cm apart and cover with soil and sand.



4- Mulch with well prepared dry grass and water the bed.