

Practical Tomato Cultivation Guide

during the Rain Season

for Extension Officers



Draft ver.1



**We don't like to be soaked under the rain,
Tomatoes don't like to be soaked under the rain.**

“Rain-Shelters for Tomato Production”

The new method to make your tomatoes happy to grow more

Preface

Tomato (*Lycopersicon esculentum*) although is generally known to be a warm season crop, it can be grown throughout the year in Zambia. There are a number of varieties of tomato that are available on the Zambian market today that include among others; Khaki, Roma VF, Heniz 1370, Beauty, Herald, Tengeru 97, Rodade, Floridade, Nemonate, Roforto VFN, Rosso, Money Maker etc.

This wide range of tomato varieties provides a farmer a good opportunity to choose from depending on the characteristics of a particular variety in relation to the season.

Tomato yields in Zambia average 25 – 50 ton per Lima (0.25ha). Therefore the crop provides farmers a good alternative to annual cash crops such as maize, beans, ground nuts whose national average yields are 2.73, 0.68 and 0.66 tones respectively (CSO 2010/2011 crop forecasting survey report) Farmers would therefore obtain higher income from tomato on the same pierces of land as compared to the commonly grown annual cash crops.

Although tomato is grown throughout the year in Kasama district, fungal diseases have been a major challenge especially during the rainy season. Prevalence of fungal diseases is high in the district due to the high rainfall experienced almost every rainy season. The direct contact of plants to rain drops, coupled with other predisposing factors such as high temperatures makes the micro environments around the tomato plants suitable for the development and spreading of fungal diseases thereby limiting full yield potential. Consequently

farmers obtain low yields and poor quality tomato fruits which ultimately result in low income.

This field guide book provides simple but practical means of minimizing the effect of direct rain drops on tomato plants during the rainy season. The method has been experimented and applied in Chilyaeka village of Kasama district where the Japan Overseas Cooperation Volunteers (JOCV) has been working with the local community. The method has so far produced good results.

The Japanese volunteers therefore found it necessary that the technique is transmitted to other communities of the district so that the benefits can be shared with a wider farming community.

The book also contains general tomato production information that is useful to both agricultural extension officers at field and at district level as well as farmers.

I wish to thank the two Japanese volunteers (Yukari Kitada and Fumiko Kakehi) who were based at Kasama district Ministry of Agriculture and Cooperatives (MACO) offices at the time of production of the guide book for their wonderful effort in producing this booklet.

I would like encourage all extension officers to make use of the booklet to enhance tomato production especially in the rainy season so that farmers can obtain high income from tomato production throughout the year.

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Contents

Foreword.....	1
Introduction.....	2
STEP 1: Seed Selection	3
STEP 2: Site Selection.....	3
STEP 3: Land Preparation.....	3
STEP 4: Planting Time.....	4
STEP 5: Fertilizer Application.....	4
STEP 6: Planting Seeds.....	5
STEP 7: Weed Control and Rogue	5
STEP 8: Controlling Insects	6
STEP 9: Making a Shelter.....	7
STEP 10: Transplant	8
STEP 11: Controlling Disease	9
STEP 12: Monitoring	12
STEP 13: Harvest	12

In Zambia, a tomato is one of the most important crops for both commercial and consumption. In addition, a tomato is very nutritious crop, therefore it can support people's health.

However in the rainy season especially, it is difficult for farmers to grow tomatoes due to high infestation of some fungal diseases such as Late bright and Early bright. Introduction of shelter in order to produce the effect of rain has been introduced in this guide book.

In this guide book, technical methods have being introduced to grow tomatoes in the rainy season including a shelter. Every steps are essential for a good harvest. You may be unfamiliar with some ideas. However these ideas had already been demonstrated by farmers in Kasama, and the guide is made based on their experiences.

During the rainy season a whole sale price of tomatoes is higher than the dry season. Therefore it can be a highly profitable crop. Through growing tomatoes in the rainy season, farmers can expand their opportunity to get cash income not only selling maize.

This guide book is an attempt to expand shelter tomatoes. It can assist extension officers and farmers. It is hoped that this guide will be found useful by them in their field.



STEP 1: Seed Selection

Selection of appropriate seeds can lead to high yield. You should choose the suitable variety depending on a season. During the rainy season, *Roma VF*, *Herald*, *Monoprecos*, *Tengeru97* and *Rodade* are recommended.

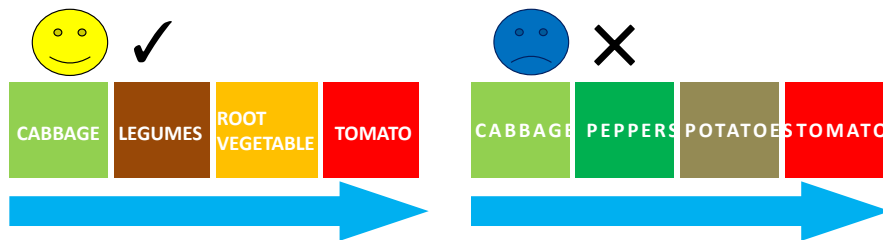
Tengeru97 is highly recommended variety for the rainy season particularly. *Tengeru97* not only yielded more than the previously grown varieties, but also due to firmer outer membranes it is less vulnerability to pests and diseases as well as to damage during transportation.

STEP 2: Site Selection

The site should be well-drained place in the rainy season. If it is the first time to grow tomatoes in rainy season, it is recommended to make a bed next / close to your house for easy and frequent monitoring.

Crop Rotation

Tomatoes must not be grown on the same land that had potatoes, eggplant, peppers and tomatoes in the last 2 years. Crop rotation can avoid some diseases, and keep fertility.



STEP 3: Land Preparation

Seedbed Preparation

A fine seedbed is indispensable to make strong seedlings. You should choose a well-drained and un-shaded area. Dig soil deeply and break large clods. Weeds should be removed so that seeds are planted in a clean field. Seedbed should be raised to 20~25cm high.



Burning the straw on the seedbed can help sterilize the soil. After that, apply 3-5kg of well decomposed manure per m² and mix it with soil thoroughly.

Main bed Preparation

Main bed also should be raised to a height of 35cm in the rainy season. Raised beds are used to facilitate furrow irrigation and to improve drainage.

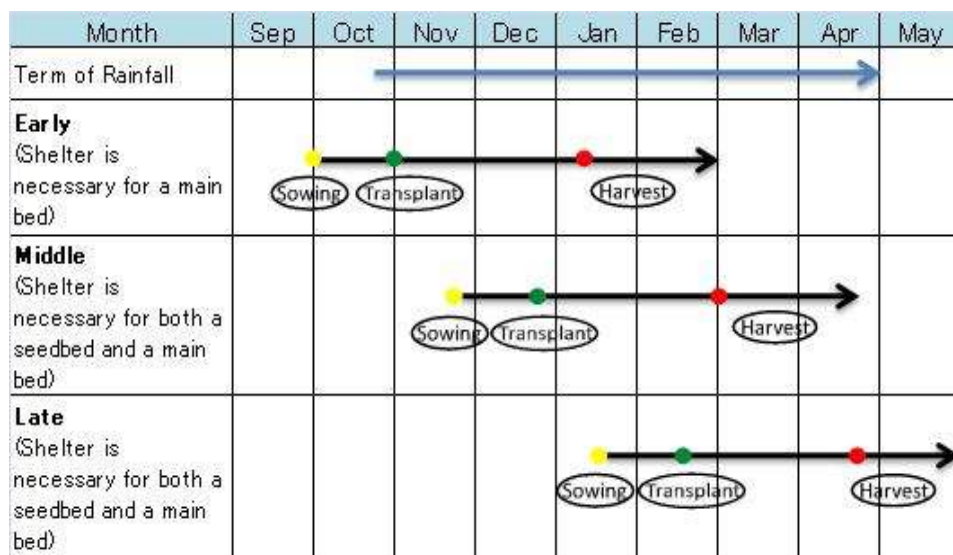


When you make a main bed, you should be considerate that a bed fits a sheet because the size of plastic sheet is limited. Mostly, a plastic sheet which is sold at your market is about 1m wide. It should be avoided to establish a bed near tomato or pepper production fields in order to prevent of diseases.

STEP 4: Planting Time

You can determine the time of planting during the rainy season for tomato depending on your demand. If you want to get big income, you better choose *Late* one, but it is the most difficult and risky.

You should avoid planting seeds in a season of the heaviest rainfall such as December. Farmer can get income constantly due to change a sowing date during the rainy season.



STEP 5: Fertilizer Application

Tomato plants should be fertilized with organic (green/animal manure) and/or chemical fertilizers for high yield.

Basal dressing: $3 \times 50\text{kg D compound/lima}$

Top dressing: $0.5 \times 50\text{kg AN/lima}$

Top dressing can be applied as split applications, that is to say at 2 weeks after transplanting and 4 weeks after flowering.

Tithonia as a Green manure

“TITHONIA” can be applied as a green manure. *Tithonia* accumulates a large amount of nitrogen and phosphorous from the soil, therefore makes a very good organic fertilizer. The stems and leaves are soft and rot easily.

How to use *Tithonia* as a green manure

Cut leaves and soft twigs before they flower, chop them into small pieces.

- As basal dressing

Place two double handfuls of fresh chopped leaves and soft twigs per station equivalent to 400g in each planting a whole 2 weeks before transplanting.

- As top dressing

Continue apply the same amount of it throughout the active period of the crop

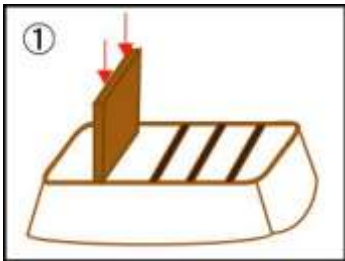
It should be buried just under the soil surface. It is encouraged to use a combination of *Tithonia* with in organic sources or animal manure because it does not fix nitrogen due to the fact that it is not a legume.

STEP 6: Planting Seeds

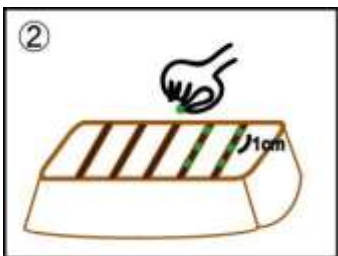
In the rainy season, growing good seedlings is the most important point to achieve the good harvest. To grow strong seedlings, the one-by-one sowing method is highly recommended, instead of drilling. Thick sowing makes seedlings spindly and it is not economic.



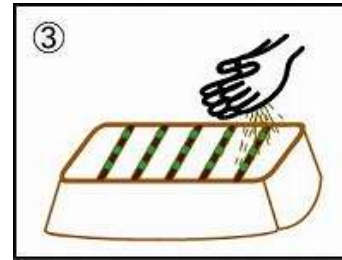
One by one sowing method



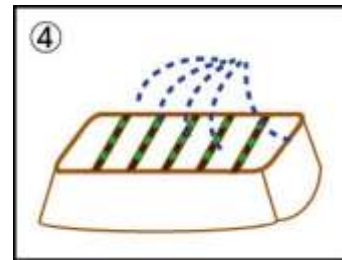
Make furrows by using the piece of timber. The spaces between rows are 10 to 15cm. these furrows enable uniformly water supply and germination.



Sow the seeds one by one. The space should be 1cm between the seeds.



Cover by fine soil. Be careful not to sprinkle the soil too much on the seed. The amount of the soil should be 3 times as thick as the size of the seeds.



After making the roof on the seed bed, tenderly watering should be done. The roof is important to avoid strong sunshine/heat and washing the seed away after watering. The roof will be removed gradually after the germination.

STEP 7: Weed Control and Rogue

Weeding should be done to prevent weeds from competing with tomatoes for moisture, light and nutrients. Sometimes weeds cause tomato diseases, such as tomato yellow leaf curl virus. Remove weeds from a bed by pulling or hoeing. Mulches suppress weed growth on the beds.

STEP 8: Control Insects

Several insects attack tomato plants. Chemical insecticides are commonly used to control them.

Fruit borers:

Tomato fruit borer is one of the most destructive pests of tomato. Tomato fruit worm and beet armyworm such as American bolt worm bore inside fruits.

Insecticide: 1ml/litre of Fastac, Karate or cyrux

Redspider mites:

This mite is just visible to the naked eye as small red granules on the underside of the leaves. It can cause severe damage and early death of the plants. It appeared mostly in the dry season

Insecticide: Abamectin, Tedion, Morocide, Omite or Tic tok



***Tephrosia Vogelii* as an insecticide**

Tephrosia vogelii can be grown to improve soil fertility, for firewood, as an insecticide against storage pests and mites on plants. It can also be used as a medicine for skin diseases and internal worms. Extract of *Tephrosia* leaves can be used for the control of pests such as termites, ants, beetles, aphids, cutworms, various bugs and weevils, stalk borers, flies and so on in the field, in storage or on domestic animals. It leaves no residue on crops because rotenone breaks down within 3 - 5 days after application.

How to make an insecticide

1. Crushing leaves. It does not need to be done perfectly.



2. After soaking the leaves in water for two hours or boiling them for 30 minutes, filter the juice through a cloth and use directly in a sprayer.

※ Approximately 1 kilogram of leaves for 5 liters of water
= Approximately 3 coke bottles of leaves for 15 bottles (1 bottle=300ml)

3. Add a bit of soap to help the spray stick to the plant.

WARNING: *Tephrosia* is dangerous to fish, humans, animals and wild life !!

- Wash hands with soap as soon as you have finished using it.
- Do not use *Tephrosia* to poison fish.

STEP 9: Making a Shelter

Making a plastic shelter, plants can avoid contact with heavy rain and splashed the soil as well. In other words, you can reduce the risk of diseases. A shelter can be made easily using local material except for a plastic sheet.

Regular maintenance should be done to maintain a shelter.

Preparations for 1bed(1×3m)

1. 10 Bamboos or Strong woods for a pillar (length :1.5m)
2. 5 Split bamboos or Slender woods for a roof (length: 1.5m)
3. Clear plastic sheet (length: 4m) *Don't choose Black one
4. Ropes from local material for tying

Procedure

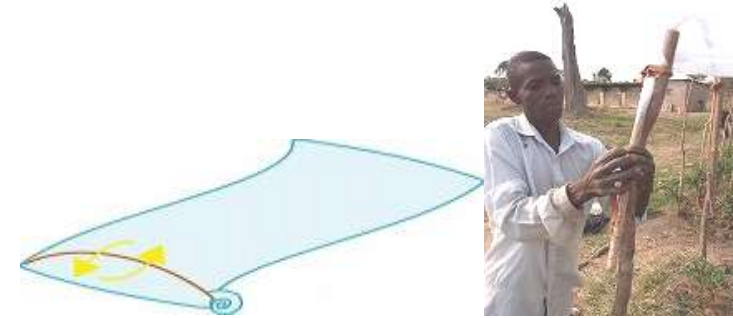
1. Set up poles around a main bed.



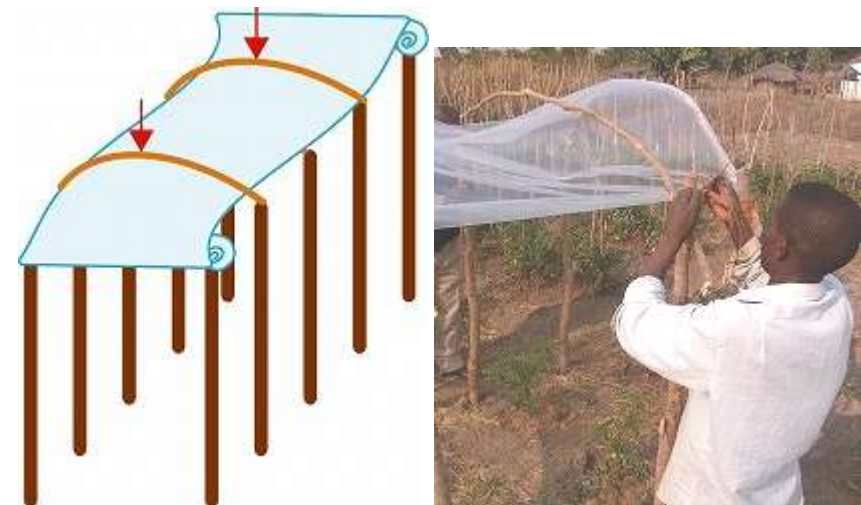
2. Make a main frame of a roof using slender wood or split bamboo.



3. Coil a plastic sheet around the slender wood or split bamboo and fixed them.



4. Put slender woods or split bamboos on a roof of a plastic sheet in order to hold a sheet against the wind.



5. Tie pole and frame. Strengthen a shelter.



6. DONE!!
Bamboo ver.

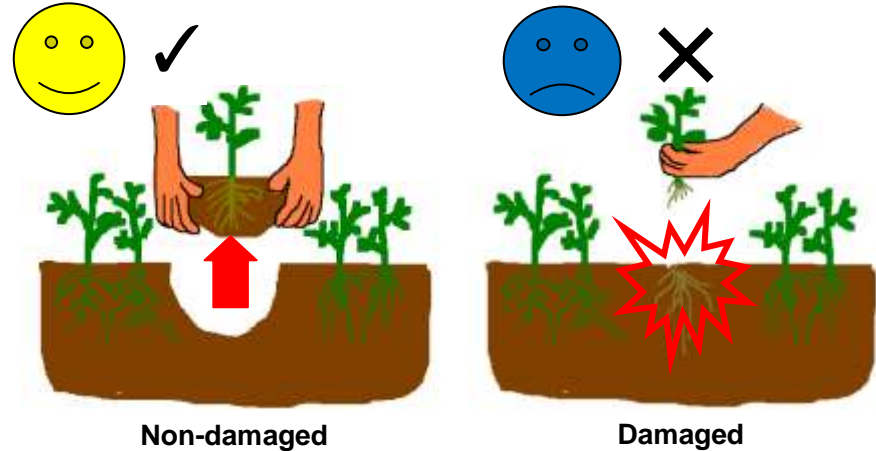


Local woods ver.



STEP 10: Transplanting

After 4 weeks of sowing, transplanting should be done. Enough watering before 12 hours of transplanting is necessary. Transplanting in the late afternoon or on a cloudy day minimize the shock of transplants. It is important to transplant with soil. If the roots are damaged, the plants get weak or die after the transplanting.



Spacing

The planting space should be more than 60cm between the row and 40cm between the plants. Space can be wider than these for better ventilation and prevention of transmission from affected plants.



Staking

As tomato plants grow, staking is needed. Staking tomato plants with bamboo or wood stakes protect plants from being in contact with the ground. It can also increase the fruit yield and size, reduce fruit rot.

When you tie the plant to the stake, the knot should be loose to leave enough space for the stem to grow.



Mulching

After transplanting, mulching should be done immediately. The mulch prevents soil splashing to the plants. Mulching is one of the most important points to prevent diseases. It demonstrates more effects when it's placed with the shelter. The straws can be used as the mulch.



STEP 11: Controlling Disease

Tomatoes suffer from many fungal, bacterial and viral diseases.

Fungal disease

Late Bright

Late Bright is the most common and serious disease in the rainy season.

Symptoms:

- Small, irregular-shaped, brown patches, appear on the upper leaf surface.
- Lesions on the stem and the petioles appear dark brown
- On fruits, the lesions have an olive-brown appearance with a rough leathery surface. The lesions may expand until the entire fruit is affected.



Control of Late Bright:

- Sowing resistant varieties seeds.
- Crop rotation
- Make a shelter
- Reduce leaf wetness by staking tomatoes, spacing plants
- Avoid over fertilization of nitrogen
- Spray fungicides for prevention every 2 to 3 weeks. Apply fungicide as soon as possible at the first sign of the disease or ideally before symptoms develop.

Fungicide:

Dithane M 45 and Copper oxychloride are available for prevention.

Dithane M 45 and Bravo are available for cure

Early Bright

Symptoms:

- Small dark spots enlarge into circular lesions on leaves and the tissue surrounding the lesions become yellow
- The lesions turn brown and eventually drop from the plant.
- Stems and petioles have elliptical concentric lesions.
- Fruit wounds or cracks may also have large, dark, leathery, sunken areas with concentric rings



Control of Early Bright:

- Sowing resistant varieties seeds.
- Crop rotation.
- Make a shelter
- Reduce leaf wetness by staking tomatoes, spacing plants
- Minimize plant injury in transplants by controlling insects and by avoiding sandy soils.
- Spray fungicides for prevention every 2 to 3 weeks. Apply fungicide as soon as possible at the first sign of the disease or ideally before symptoms develop.

Fungicide:

Dithane M 45 and Copper oxychloride are available for prevention.

Dithane M 45 and Bravo are available for cure

Black leaf mold

Symptoms:

- Black sooty patches develop on both upper and lower surfaces on leaves
- The soot-covered leaves wilt, dry and usually remain hanging on the vein.



Control of Black leaf mold

- Sowing resist variety seeds
- Crop rotation
- Make a shelter
- Apply protective fungicides (Dithane M 45 or Cooper oxychloride)
- Reduce leaf wetness by staking tomato plants, spacing plants

Gray leaf spot

Symptoms:

- Brown to black specks appears on both the young and older leaves.
- The lesions expand slowly into 1- to 2-mm-diameter round spots that remain brown or develop a gray center surrounded by a yellow area.
- A lot of lesions causing entire leaves to turn yellow, then brown and drop.

Control of Gray leaf spot

- Sowing resistant variety seeds.
- Crop rotation.
- Make a shelter
- Apply protective fungicides (Dithane M 45 or Cooper oxychloride)

Bacterial disease

Bacterial Spot

This is a seed and wind borne disease.

Symptoms:

- Tiny, circular and dark lesions on leaves
- Lesions may coalesce, causing blighted areas on leaves
- Immature fruit show brown, slightly sunken scabby spots.
- Lesions on stems are elliptical in shape.



Control of Bacterial spot

- Sowing resistant varieties seeds.
- Crop rotation
- Make a shelter
- Apply protective fungicide (Cooper oxychloride) at weekly intervals

Abnormalities

Cracking

Cracking tomato suffer due to erratic irrigation. You should be maintained even moisture by watering regularly and mulching.



Blossom end rot

Blossom end rot outbreak due to calcium deficiency and heavy applications of Nitrogen. You should be maintained moisture by watering regularly and mulching.



STEP 12: Monitoring

Monitoring is essential for good yields. You should detect problems of plants or a shelter as soon as they emerge. It can reduce the risk.

It is recommended to make a calendar to check a field. Farmers can manage their working using a calendar.



Example

Pali cimo	Pali cibili	Pali citatu	Pali cine	Pali cisano	Pa cibelushi	Pa mulungu
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Monitoring(ukumona)...**M** Weeding(ukusekwila)...**W** Fertilizer(umufundo)...**F** Chemical(umuti)...**C**
Sowing(ukutanda)...**S** Germination(ukumena)...**G** Transplanting(ukulimbula)...**T** watering(ukutapilla)...**A**
Harvest(ukusombola)...**H**

STEP 13: Harvesting

Harvest fruits during cool periods, such as early morning or late afternoon. After the harvesting, don't mix damaged fruits with undamaged fruits. Poor care of fruit after harvesting will lead to poor fruit quality.

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AVRDC- the World Vegetable Center www.avrdc.org
World Agroforestry Center <http://www.worldagroforestrycentre.org/>

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