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National Centre for Organic Agriculture, Yusipang
Department of Agriculture Ministry of Agriculture and Forests
Thimphu, Bhutan

Organic Tomato Production Manual

"A guide to tomato production"

Tashi Gyalmo
Horticulture Officer
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NCOA/TECHNICAL/21-22/4

P.O Box #. 212, Phone No.; (975) 77191123 (PD), 77992000 (Fax), 77191124, 77191125, 77191126 (EPABX)

Editor: (1) Laxmi Thapa, Dy Chief Research Officer (National Vegetable Commodity Coordinator, NCOA, Yusipang

(2) Tshering Wangchuk, Research and Communication Officer, Technical Support Services, NCOA, Yusipang

Design and Layout: (1) Laxmi Thapa, Dy Chief Research Officer, NCOA, Yusipang

(2) Tshering Wangchuk, Research and Communication Officer, Technical Support Services

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1 BACKGROUND

1.1 Introduction

Tomato (*Lycopersicon esculentum*) falls under Solanaceae family. It is rich in Vitamins A, C, & Lycopene and antioxidants. Tomato is a native of the lower Andes, cultivated by the Aztecs in Mexico. Tomato is one of the most important additive vegetables in the Bhutanese dish. They are also eaten raw as salad. In Bhutan, tomatoes are cultivated in limited areas. Tomato production in the country according to Agriculture statistics 2019 was 148.05 acres with a total production of 232.66MT) and is considered deficit as per the vegetable production analysis of the Department of Agriculture, MoAF. The production cannot fulfill the local demand and hence major portion of tomatoes are imported from India. However, given the various agroecological zones, Bhutan has potential for year-round production of tomatoes with appropriate technology and production practices. The research conducted at National Centre for Organic Agriculture (NCOA) indicates higher yield from tomato cultivated under protected structures.

1.2 Objective

This manual will provide in depth production method of tomato cultivation in two parts; (1) focuses on general open cultivation method of tomato and (ii) On protected cultivation methods with the objective to;

- Provide tomato growers with hands-on information and technology on tomato production
- Increase production with appropriate cultivation methods

There are two types of tomato plants, determinate (bush) and indeterminate type (vining types which needs pruning and training). The available varieties in Bhutan from the National Seed Centre (NSC) are***: PS 61(Hybrid indeterminate) Ratan (OP indeterminate) and Roma (OP determinate).***

However, there are other hybrids like Cosmic, which has been released recently in 2020-2021. Other open pollinated lines from the World vegetable Center, Taiwan are also under evaluation which is expected to be released soon if found to be possessing superior quality like high yielding and disease resistance.

Table 1. ***Tomato Variety released in 2021***

Commodity	Scientific name	Initial Variety name	Released name	Yield range (MT/ac)	Altitude range(masl)
Tomato (OP)	*Solanum lycopersicum*	Red Tommy Toe	*Bajo Lambenda 2*	10-13.3	< 1800
		Master	*Bajo Lambenda 3*	8.2-11.6	<1800
Tomato selection (OP)	*Solanum lycopersicum*	Srijana	Wengkhar Lambenda 1	10-14	<1400

Variety	Yield (tons/acre)	Agro-zone(masl)	
Tomato: COSMIC	25-35	<2600	
Tomato: 7GARV	25-35	<600	

2 AGROECOLOGICAL REQUIREMENTS

2.1 Climate

Tomatoes can be grown in a wide range of temperature and soils, but it grows well when the day temperature is between 13ºC to 35ºC.
Tomato is considered a warm season crop. It is sensitive to frost and high humidity will favour disease development. It will not grow perpetually outdoors in temperate regions. It is recommended to grow tomato in a protected structure in the temperate areas of the country. Most available varieties can be grown outdoors in the warmer regions.

Ideal altitude for tomato production in Bhutan is between 300masl to 2200masl. However, it does well at an elevation close to 3000 masl under protected structures. Tomato can be cultivated from 300masl (in the south) during winter, while in the mid altitude from March to October. The crop is grown during summer in the temperate areas. In the higher altitude (2200masl-2800masl), it is recommended to cultivate tomato under protected cultivation.

2.2 Soil

Tomatoes can be grown on a variety of soil types. They grow optimally in deep, medium texture loam and sandy loam soils, fertile, well-drained soil. Avoid sites that tend to stay wet.

The best soil pH range for tomato is 6.0 to 7.0. Apply dolomite powder at the rate of 1.5 mt per acre if the soil pH is below 5. Do not use land and soil that was previously planted with solanaceous crops (Chilli, potato, eggplant). At least a rotation of 2-3 years gap is recommended.

3 CULTURAL PRACTICES

3.1 Nursery

3.1.1 Nursery bed

The nursery should be prepared thoroughly before sowing the seeds. Remove the stones or clods and other unwanted materials for the uniform and healthy growth of the seedlings. Possibly add sieved leaf mold or compost on top of the bed. Raise nursery beds of 15-20 cm high, 1 m wide and convenient length. For faster germination and growth, raise nurseries under protected structures or low-cost poly-tunnels. This will also protect crops during heavy rain, frost and sun (green net tunnels)

3.1.2 Seed sowing

Sow the seeds 1.5 cm deep and 8-10 cm apart in rows *(thumb rule for depth: double the size of seeds).* The growing season varies depending upon the altitudes. The time of sowing, transplanting and harvesting at various agro-ecological are as follows:

High altitude (>1800):	March-April
Mid altitude (1200-1800):	February-May
Low altitude (<1200):	September-October

In the higher altitude areas above 1800masl, it is advisable to use poly-tunnel having semi-circular structure of bamboo sticks over the nursery bed. The plastic sheet is laid over the structure and the sides are covered with soil. Open the plastic during the day time and close it in the evening.

Figure.1. ***Nursery production technique***

Irrigate the nursery as and when required based on the soil conditions and daily weather pattern. Maintain optimum moisture of the nursery beds. Avoid over-watering as this may lead to damping off or rotting of the seedlings in the nursery.

3.1.3 Seed rate

Seed rate depends on the variety. For hybrids we can use 60-100 g of seeds for an acre while for open pollinated sow 200g with germination of 75% for one acre.
Hybrid seeds are recommended for commercial production as it is better in yield, disease resistant and has better-shelf life. Prices of hybrid seed will be higher compared to open pollinated (OP) and seeds need to be purchased yearly as hybrid seed are produced through hybridization only.

3.2 Field preparation

Plough the field three to four times to pulverize the soil. Good drainage of the field is of great importance and is a prerequisite for cultivation of solanaceous crops, especially in summer. It is advised to grow solanaceous crops on raised beds of 15-20cm height and 1m width. The length of the bed depends on the field condition or topography. Do not use semi-decomposed organic manures or compost made out of city waste in the nursery soils as these are the reservoirs of number of pests and diseases. It is recommended to use sieved compost on the top of the nursery beds

3.3 Transplanting

Tomato seedlings should be ready in a month after sowing. Transplant the seedlings on the raised beds with the row-to-row distance of 50-60 cm and plant to plant 40-50 cm. However, the spacing will also be determined by varieties. It is estimated that an acre of land can accommodate 40,000seedlings. It is recommended to harden seedlings before transplanting which can be done by withholding irrigation intermittently. In the poly tunnel, nursery should not be covered by plastic or net 1-2 weeks before transplanting. Nursery trays should also be taken out and hardened outside before transplanting. Seedlings should be 12cm high or four-five leafed during transplanting. Transplant seedlings during evening hours and irrigate immediately.

Figure 2. ***Transplanting technique***

3.4 Irrigation

Water the young plants at field capacity for few weeks after transplanting to encourage good vegetative growth. Reduce amount of irrigation and frequency in 4-5 weeks after transplanting to provide little water stress which will enhance tomato flowering and production.

After the fruit set, maintain uniform soil moisture to avoid blossom-end rot, fruit cracking and to improve fruit quality. Reduce irrigation slightly towards the time of harvest to get good flavour and less watery fruits. For best outcome, micro-irrigation or drip irrigation is recommended. However, if the irrigation needs to be done manually, then watering should be done at the root zone of the plant to avoid wetting of the plant parts and the subsequent disease outbreak.

1. Irrigation before transplanting 2. Transplanting 3. Irrigate on roots 4. Drip irrigation

Figure 3. *Irrigation Technique*

4 CROP MANAGEMENT

Staking and pruning are two of the most important cultural practices for optimal tomato production. However, it is often neglected by our farmers. Step-wise staking and pruning methods are described as below:

4.1 Staking

The main reason for the staking requirement of the plant is to provide support to the tomato plants and to keep the plants and fruits off the ground. All indeterminate varieties are trained with wires, strings or stacks to prevent lodging and to reduce losses from fruit rot when the fruits come in contact with the ground. Staking can be done by means of:

a) Wooden poles or individual stakes: Wooden poles or bamboo stakes are provided near the plants and the plants are tied to the supporting structure by tying with a rope at regular intervals as the plants grow. Ideally staking should be done right after planting to minimize damage to root system and plants can be tied to stake when they are12-15inches tall before any sign of lodging.

b) Strings attached to the hay wire (horizontal GI wire): 2-2.5 m long poles are erected on either side of ridges for stretching GI wire. Jute ropes or other strings are then attached to the haywire stretched at a height of around 2m from the ground and the plants made to trail along. Branches of plants are supported on the poles or strings with twines of the plants.

Figure 4. ***Staking of tomato (Centre-Right stage of staking, right-Haywire staking)***

4.2 Pruning

Pruning refers to the removal of side and lower shoots, unwanted or axillary and diseased shoots or parts to:

- Enhance vigor and productivity of plants.
- Divert nutrients to flower clusters and fruits on the main stem & increase fruit set.
- Allow efficient air circulation & prevent diseases.

Use clean, sharp, scissor-type hand clippers/ secateurs for tomato pruning.

Steps in Pruning:

Step 1: Determine the variety you are growing

A. Pruning Indeterminate Tomatoes:

- Prune indeterminate varieties to one, two or three stems/leaders.
- Allow two or three side shoots to develop (one below the first flower cluster and the other below the second stem).
- Prune the plants by clipping off the side shoots/axillary shoots till the first flower cluster.
- Allow all the axillary shoots to develop after the first flower cluster for optimum yield (figure 5)
- Determinate varieties require minimal staking and doesn't require heavy pruning for good crop yield.

Pinch off this axillary shoot *Prune off dead, dry and diseased leaf at the base*

Figure 5. ***Pruning tips for tomato***

Research conducted at NCOA-Yusipang on the effect of various methods of pruning on tomato growth and yield showed that pruning the plants to a single leader yielded larger and uniform sized fruits followed by double leader system.

The fruit quality and size are superior in the clean and healthy single leader system, while the multi-leader or unpruned plants with excessive vegetative growth looked diseased with inferior quality fruit.

4.3 Weed management

Two to three weeding is necessary depending upon the weed pressure. Weed manually or use garden hoe without damaging the roots. Under organic management, the use organic mulches are highly recommended for its multiple benefits besides weed control. The use of plastic mulches also reduces weed pressure substantially.

4.4 Mulching

Mulching with any kind of organic matter like paddy straw or Artemisia leaves is found to be having synergistic effect in plant growth and yield. Organic mulch materials create congenial micro-climate for plant growth by way of retaining heat and moisture, suppressing weed and disease pressure. Mulch materials like artemisia leave also exhibit pest-repellent properties.

The use of black plastic mulch is also becoming increasingly popular.

Artemisia leaf mulch *Plastic mulch*

Figure 6. ***Mulching of tomato with artemisia and plastic***

4.5 Plastic mulches

The use of plastic mulches in commercial production and of staked tomatoes is almost universal. It can be used to reduce weed pressure, conserve moisture and fertilizer and to promote earliness by capturing heat, increasing soil temperatures and accelerating growth. Other advantages include fruit cleanliness. Drip irrigation is recommended for plastic mulched tomato production. By using drip, disease is often reduced as foliage stays dry and soil is not splashed.

There is cost involved in the purchase of plastic mulches as well as drip irrigation. Removal and disposal involve additional labour cost. Studies have revealed that mulch culture increases yield and yield significantly to offset the cost involved (Kelly T.W, 2015).

In Bhutan, black plastic mulch is commonly used. It usually comes in a width of 1 meter. Therefore, it is recommended to prepare bed width of 80cm. After mulching, holes are punched at recommended spacing of

40cm-50cmPP on two rows. Holes can be punched by a simple tool of metallic can which is fixed in a 1m wooden pole. The can is heated and punched on the plastic after mulching the beds. Some farmers also use a fabricated tools with sharp edges to punch holes.

Plastic mulching *Weed pressure only around exposed root zone* *Punching hole*

Figure 7.*Punching of holes in plastic mulch*

4.6 Nutrient management

4.6.1 Farm yard manure

About 10 tonnes of Farm Yard Manure (FYM) or vermi-compost/compost @ 1-1.5 t per acre is applied at the last ploughing. Green manuring is recommended for areas with assured rainfall and also for irrigated crop.

For non-organic growers, fertilizer recommended is 20:24:15 kg of NPK per acre as basal dose in the form of Urea, SSP and MoP with top dressing of additional 26 kg nitrogen after one month of transplanting. Top dressing of nitrogen should be done in the forms of rings around the plants and cover with soil.

4.6.2 Liquid Bio-fertilizer

Farmers are also encouraged to prepare their own compost and vermicompost in organic farming. For Organic farmers, it is recommended to use home-based bio-fertilizer such as Jeevamrut *(Rangzhin luechu*) and Jholmal 3(*Rangzing bupmen*). These technologies are popular in organic farming and are practiced at NCOA. A brief preparation procedure is as described below:

Table 2. ***Preparation and Application of Bio-fertilizer (Jholmal and Jeevamrut***

1.Preparation and application of Jholmal 1 (Liquid Bio- Fertilizer) (*Rangzhin luechu)*
✓ Use 17 kg well-decomposed cow dung/farmyard manure +16 litres of cow urine, +16 litres of water, +1 litre of EM
✓ Mix in 50 litres of drum, Ferment for 15days
✓ Sieve the fermented solution and apply on foliage. For soil application fertilizer can be used without sieving
✓ Apply it by pouring on soil at the base of plants. It can be used effectively for 15 days
✓ Recommended dilution is (1:1) 1litre water and 1 litre of *Rangzhin chu*
2.Preparation and application of Jeevamrut (*Rangzhin luechu 1)*
✓ T200 liters of water

+10kg cow dung,1 kg lentil,1kg jaggary,.5 liters cow urine, a handful of soil

- ✓ Mix all ingredients in a drum/bucket and let it ferment for 5 days. Stir it 3-4 times in a day
- ✓ After five days solution can be applied in the ration of 1:1 water and Jeevamrut
- ✓ This quantity is sufficient for an acre of land and solution can be used effectively for 8 days

5 HARVESTING

Tomato starts yielding by 70 days after planting, but maturity also depends on the varieties. Harvesting maturity depends on the purpose whether for fresh market, processing, long distance transport etc.

Following maturity standards are recognized in tomato:

- Mature green: Harvested for long distance market.
- Breaker stage: Harvested for long distance market.
- Pink stage**:** Harvested for local market.
- Light red: Harvested for local market.
- Red ripe or hand ripe: Harvested for processing and seed extraction

Tomato at mature green stage *Tomato at breaker stage* Right stage of tomatoes for local market -pink and red ripe

Figure 8. ***Tomato harvesting stages***

6 SEED EXTRACTION

Seeds can be saved for future use only in cases of open pollinated varieties. The seeds of hybrids on contrary cannot be saved for use in the following years as the seeds won't breed true. Tomato fruits for seed extraction are harvested after they attain full maturity. The fruit from first harvest and last harvest are not recommended for seed extraction. Before seed extraction, fruits are to be graded) for true to type. The selection of medium to large size fruits for getting higher recovery of quality seeds is recommended.

The extraction of seeds from ripe fruits is done by fermentation method and acid method. In fermentation method, the crushed fruits are allowed to ferment for 1-2 days and then put in water where the pulp and skin float and the seeds settle down at bottom. The seeds are then separated by washing in a sieve.

In acid method, the fruits are crushed into pulps in a plastic bucket (do not use zinc and iron container). And then 100ml of Hydrochloric acid per 14kg of crushed tomato fruits is added. One to two times stirrings in between will facilitate the separation of seed and pulp. After 30 minutes, the

seeds get separated from the pulp and settle down at the bottom of the bucket. The floating fraction is removed. The settled seeds should be washed with water for three to four times. The washed seeds are dried in a partial sun light.

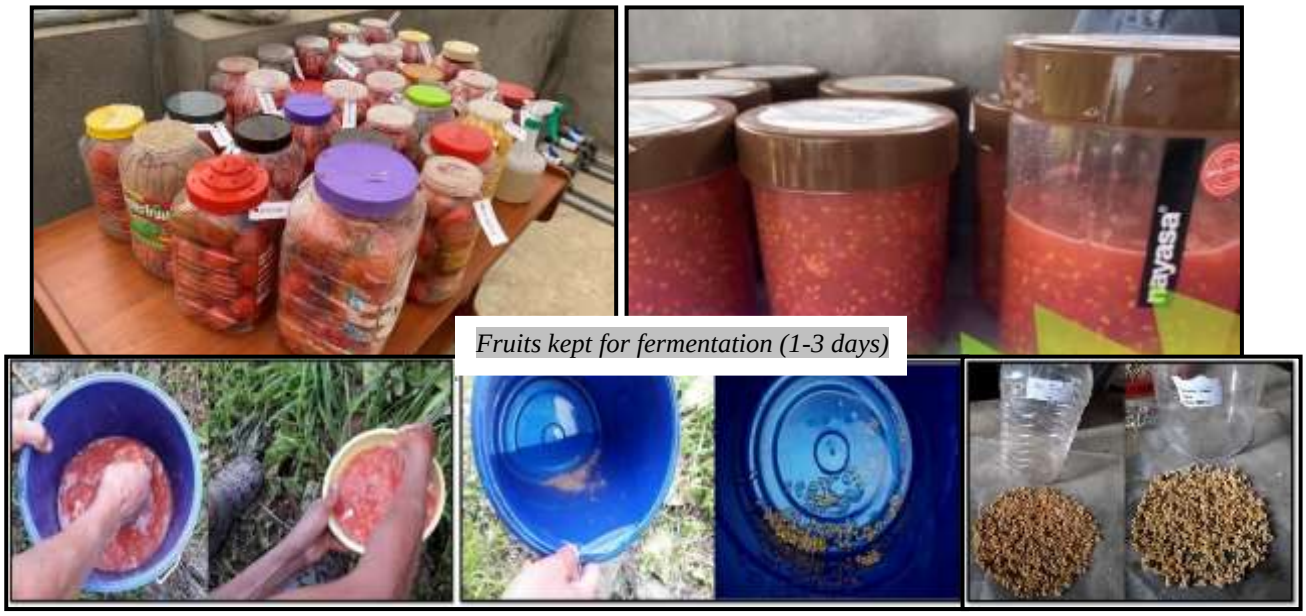

Figure 9.*Tomato seed extraction by removing pulp*

6.1 Drying and storage

After proper drying, the seeds should be processed to maintain high vigor and viability by removing immature and small seeds. Remove broken, immature and diseased seeds, other inert matters. The seed should be dried to bring the moisture content up to 8% before storage. Store the seeds in air-tight containers like vapour proof jars, zip lock plastic bags or plastic containers (pet bottles). Seeds should be stored in a cool, shady and dry place. Place the seeds in a refrigerator (below 15^{o}C is ideal) for long term storage.

7 PLANT PROTECTION / PESTS ANDDISEASES

7.1 Diseases

The common insect pests in tomato are cutworms, and fruit borer while diseases mainly are damping off, blight and blossom end rot. All these should be managed following the principles of IPM technologies.

Damping-off

Damping off disease is caused by a complex of soil-dwelling fungus. It occurs in nursery and when it occurs the whole nursery is destroyed within a short period of time. Therefore, to avoid the occurrence of this disease, farmers are advised to:

- Raise nursery in a well-drained soil because this disease occurs in moist soil with inadequate drainage. It is a soil-borne disease and partial sterilization of soil can be done by burning trash on the nursery beds before sowing the seeds. The disease incidence can also be reduced by avoiding nursery sowing in the same bed.

For non-organic growers:
Farmers are advised to treat the seed with Thiram or Captan (fungicides) before sowing @ 2 g per kg of seed. Alternatively, drench the nursery with Mancozeb solution @ 3g per litre of water as soon as the symptoms appear.

Tomato Early & Late Blight
Early blight is a fungal disease caused by *Alternaria solani* while late blight is caused by *Phytophthora infestans*.

- As a preventive measure, remove crop residues soon after the harvest is over and convert it into compost. This practice will reduce proliferation of disease in the next crop.
- It is advised to grow the plants under protected conditions as wetting the plants either through irrigation or rainfall aggravates the disease incidence.
- There is no variety that is resistant to late blight. The only alternative is to minimize the loss due to late blight is through good crop husbandry (removal of infected parts with immediate effect and the clipping off of lower plant parts up to 20-30cm, mulching, etc.)
- Practice crop rotations. Maintain at least three years rotation gap especially in the open field. Since the greenhouse cultivation has lesser blight incidence seasonal or one year rotation is also found to be effective.

For Non-organic growers:
Spray application of fungicide Mancozeb @ 3 g per litre of water is recommended if cultural practices fail and repeat the spray in every two weeks.

Blossom end rot
It is a physiological disorder caused by deficiency of calcium in plants. It is aggravated by wet growing season followed by dry spell at the onset of fruit setting.

- Good irrigation and drainage practices with consistent supply of moisture throughout the growing season and proper staking for intermediate varieties is crucial to control this non-parasitic disease.
- Additional calcium supplement will also help to restore the disorder. A simple practice of adding crushed egg shell around the root zone of the plants can help rectify the problem too.

For Non-organic growers:
Spray Calcium Chloride @100g/21liters of water once a week for 6 weeks if there are symptoms.

Blossom end rot *Fruit borer infected fruit*

Figure 10. ***Pest and Disease***

7.2 Pest

Fruit Borer (Helicoverpa armigera)

The larvae of the pest bore into fruits by inserting their heads inside. They move from fruit to fruit and damage them, making it unfit for marketing. Presence of round holes on the surface of fruits is the characteristic symptom of the pest damage.

As control measures, following steps are recommended:

- Trap cropping with marigold in the ratio of 1:16.
- Hand picking of the larvae.
- Installation of pheromone trap, Helilure @4/acre.
- Spray application of *Bacillus thuringiensis var. kurstaki*as a biological pest control measure.

7.2.1 Organic Pest Control

Neem oil

Using neem oil as organic insecticide and fungicide

Neem oil comes from the tree *Azadirachta indica*. Oil is extracted from most part of the tree. The effective compound is Azadirachtin which is found to be the highest in the seed. It has anti-fungal and pesticide properties. It is non-toxic and can be used in all types of agricultural plants.
It is used to manage over more than 200 species of chewing and sucking insects. Further, it is useful against fungi, mildew and rust (npic.orst.edu).

Neem oil can be sprayed as:

- Foliar spray: Spray on both sides of leaves and stem at the rate of 5ml/liters. It is found to be effective against caterpillars and aphids at NCOA.
- Soil spray: Soil drench @5ml/liters around the plants for insects, soil pest and fungus.
- Neem oil is available at National plant protection Centre (NPPC) and the price for 100ml is Nu.58/-.

Home based bio-pesticide: farmers can prepare home based bio-pesticides depending on the availability of materials

Table 3. ***Locally available plants that can be used as bio-pesticides***

English name	Local name	Botanical name	Parts used
Artemisia /Mugwort	Khempa sshing (Dz)Titaypati(Lho)	*Artemisia vulgaris*	**Leaves and stem**
Stinging nettle	Zocha (Dz), Sisnoo (Lho)	*Ultia dioica*	**Leaves and stem**
Malabar nut	**Basikha (Dz), Asuro (Lho)**	***Justicaadhatoda***	**Leaves**
Sichuan pepper	**Timur (Lho)/Thingay (Dz)**	***Zanthoxylum simulans***	**Seed**
Persian lilac	Bakaino	*Melia azadirachta*	**Leaves and fruits**
Indian lilac	Neem	*Azadirachta indica*	**Leaves and fruits**
Marigold	Sayapatri (Lho) Sergimeto (Dz)	*Tagetes erecta*	**Leaves and stem**
Siam weed	Banmara (Lho)	*Chromolaena adorate*	**Leaves and stem**
Peach	Aaru (Lho)Khamshing(Dz)	*Prunus persica*	**Leaves**
Others: Ginger, Chilli, Garlic, Onion			

Preparation of Jholmal (*Rangzhin bupmen*)

- ✓ Chop leaves of locally available plants with bitter, sour or pungent smell and fill in drum
- ✓ Fill up the drum with equal amount of cow urine and water
- ✓ 1 litre of EM/jaggary solution
- ✓ Ferment for 21-30 days
- ✓ After 30 days it can be used. Mix 1 liter of solution in 1 liter of water.

8 PROTECTED CULTIVATION OF TOMATOES

Tomato is one crop that is highly recommended to be grown in side protected structures. The crops grown in open field conditions in summer is highly prone to blight disease. The devastating disease infects and destroys the leaves, stems as well as fruits and gives the entire plant population a blighted black appearance. Planting tomatoes in protected structure increases length of harvest (early and late harvest) and increases yield.

The protected structures can be high-tech ones or simple low-cost poly-houses or rain shelters. Different types of Low-cost polyhouses and rain shelters can be constructed for tomato production;

1. Low cost poly-house with cover on the roof only
2. Simple Poly-tunnels rain shelters (domed shaped)
3. Rain shelter with bamboos (sloppy roof)
4. Low-cost poly house constructed with bamboos with fully covered plastics
5. In Bhutan the most common fabricated polyhouses are 10mx5m and 20mx5m supplied by agents.

a. Polyhouse from bamboos (fully covered)

b. Low cost domed shaped polytunnel

c.Low-cost Rain shelter (sloped roof)

d. Tomatoes under fabricated polyhouse

e. Tomatoes under low-cost bamboo polyhouse (With roof covering)

f. Production in bamboo rain shelter (sloped roof)

Figure 11. ***Tomato under different protected structures***

Figure 12. ***Construction of different low-cost structures***

Low cost domed rain shelter can be made with wooden poles and battens (low-cost installation in farmer's field)

Figure13. ***Low cost protected structures with wooden poles***

Description of three types of low cost protected structures

(i) Low cost domed shaped rain shelters

Plastic rain shelters are very simple structures, covering the plants along the rows ***(Figure 11b & 12).*** Height of domed shaped rain shelter should be 1.8-2m, width should be 1.5 with the length of 10 m. The plastic rain shelters are erected with bamboo or wooden poles of about 1-2" diameter. Transparent UV stabilized plastic sheet of 35 or 45 GSM is placed on the bamboo structures to cover the roof. The plastics are properly tied up on bamboo structures with Jute ropes. The plastic sheet protects plants from high rainfall, hailstorms and frost during winter. It helps maintain warm temperature surrounding plants.

(ii)Low-cost tunnels (bamboo poly house)

- Low plastic tunnels are like greenhouse structures, covering the plant along the row ***(Figure 11a)***
- The tunnels should be 2.5 m high and 5 m wide at base with the length of 10 m. It can be erected with bamboo sticks or wooden pole of about 1 "diameter.
- Transparent UV stabilized plastic sheet of 35 or 45 GSM is placed on the bamboo structures. The plastic sheets are firmly tied up on bamboo structures with wire or jute rope.

(iii) Rain shelters (sloppy roof) ***(Figure. 11e & 11f)***

- Prepare beds of 80cm inside polyhouse.
- Mix well-decomposed FYM or manure (2-3kg/m^2) approximately 150kg-200kg per poly-house.
- Mulch beds with black plastic mulches/artemisia/straw if available.
- Transplant seedlings at 50cm row to row spacing maintaining two rows per bed.
- Irrigate immediately.
- Follow Intercultural operation instruction as mentioned earlier in this manual

9 CROPPING CALENDAR

Table 4. ***Tomato cultivation cropping calendar***

Zones	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
>1800												
1200-1800												
<1200												
		Sowing				Transplanting				Harvesting		
		Sowing in polytunnels for early crop										

10 COST OF PRODUCTION

Table 5. ***Cost of production for organic tomato***

Income	**Yield (kg/acre)**	**Farm gate price (Nu.)**	**Total Income/acre (Nu.)**	***Total of capital cost***	**Total of variable cost**	**COP**
Return from sale	22,000	50	1,100,000	477,775.8	678,425.8	34

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