



Tomato and Hot Pepper Production Guidelines



Production Guidelines for Tomato and Hot Pepper in dry season

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General note:

The production guidelines described in this document are general guidelines only. Weather conditions, such as rain, cloud coverage and wind, might have a major effect on actual water demand. Soil conditions might affect actual fertilizer needs.

Pests and diseases should be monitored periodically and treated using the relevant chemicals, according to chemical's label and safety data sheet.

For more details - contact your local vegetable specialist.

Disclaimer:

This document is intended to be used as general guidelines only, and Fair Planet is not in any way liable for any decisions and / or actions resulting from their use .

The information contained in these guidelines may contain technical inaccuracies or typographical errors. We reserve the right to make changes and improvements to any information contained in these guidelines.

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About Fair Planet

Fair Planet is a non-profit organization. Our goal is to enable smallholder farmers to increase their productivity and income through access to high quality vegetable seeds, suitable for their needs. Access to such seeds allows farmers to produce and sell significant yields with minimal changes in their farming practices. To realize this goal, Fair Planet partnered with the world's leading seed companies - Syngenta, Limagrain-Hazera, Enza Zaden, East-West Seed and Bayer.

In each agro-climatic region we perform variety trials to identify vegetable varieties best suited for local farmers' needs and together with our partners, provide these farmers with access to affordable seeds along with agro-technical training and extension visits.

Fair Planet operates a training program in Ethiopia in frame of the FDOV14ET01, implemented in collaboration with Haramaya University, the Regional Offices of Agriculture in Butajira, Dire Dawa, Harar and Haramaya, the Ethiopian Ministry of Agriculture, Fair Planet's Seed Partners, KKL-JNF, Netafim, Alterra from Wageningen University and the Netherlands Enterprise Agency.



We would like to thank all the experts and volunteers who contributed to the Third Edition of the Vegetable Production Guidelines

1. Choosing a suitable plot and crop rotation

a) What is crop rotation?

Crop rotation refers to the practice of growing different types of crops (or none at all) in the same area over a sequence of seasons. The farmers should not grow on the same plot crops from the same plant family in consecutive years.

For example: Tomatoes, Pepper and Potatoes belong to the same plant family

b) Types of crop rotation:

- One field rotation – growing a single crop with 1-2 year rest.
- Two fields rotation – alternating between two crops in two fields.
- Three (and up) fields rotation – growing a different crop in each field every year, for three to four years before repeating.
- Example (four fields rotation):

Year	Field 1	Field 2	Field 3	Field 4
1	Cabbage	Tomato	Maize	Onion
2	Tomato	Maize	Onion	Cabbage
3	Teff	Onion	Cabbage	Tomato
4	Onion	Cabbage	Tomato	Maize
5	Cabbage	Tomato	Maize	Onion

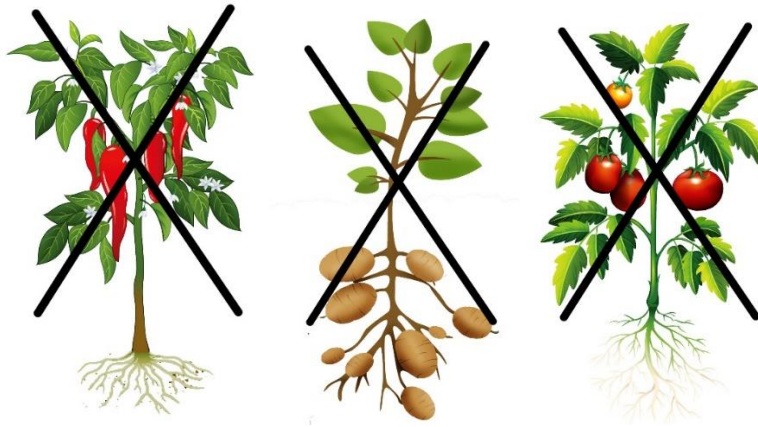
- Rotate the crops within fields, maintaining the total area of each crop.
- If crop areas are not equal, consult your local expert.

c) Groups of plants that we can rotate:

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Cucurbits	Brassicas	Solanaceae	Leaf & Root	Cereals	Legumes	Alliums
Cucumber	Cabbage	Tomato	Beetroot	Corn	Beans	Onion
Squash	Kale	Pepper	Spinach	Teff	Peas	Garlic
Pumpkin	Cauliflower	Potato	Carrot	Wheat	Soybean	Leak
Melon	Radish		Lettuce	Barley		
Watermelon						

d) Example:

For **Tomatoes** and **Hot Peppers** - choose a plot that was not used for tomatoes, peppers or potatoes for at least two years.



e) Make sure that no broad leaf herbicides (such as 2,4-D) were used on this plot for at least two years.



Why?

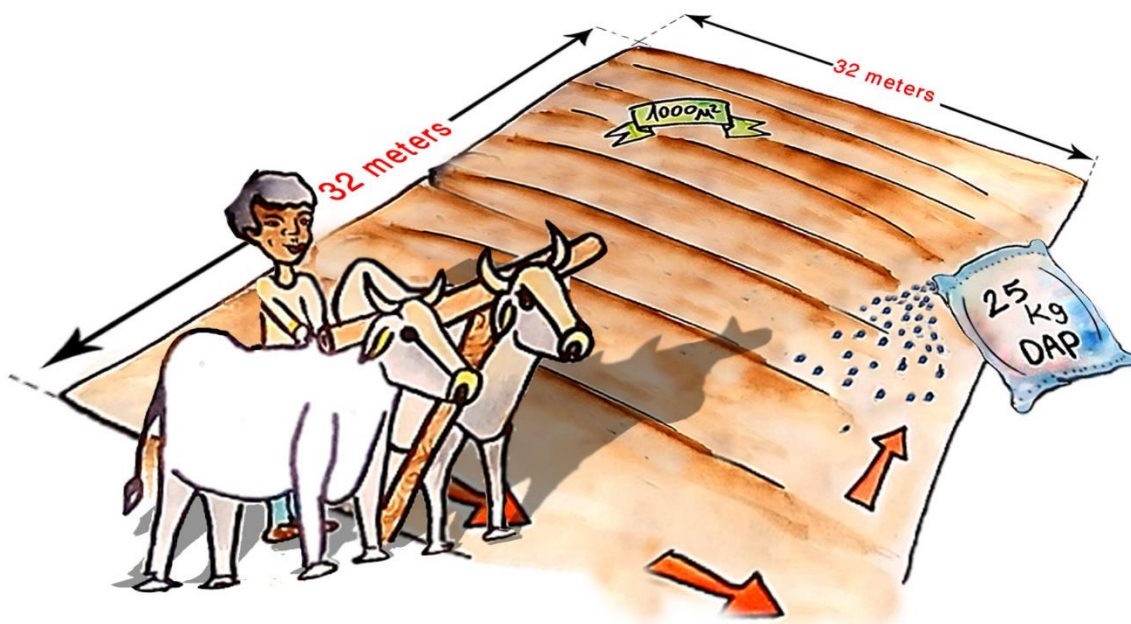
- The land can become "tired" and less fertile, because the same type of crop planted repeatedly in the same area keeps draining the land of the same nutrient.
- Certain pests can reach levels that are hard to control when they learn that the field always has the same type of crop.
- Land can be more susceptible to the forces of erosion if the same type of crop is planted repeatedly.

Why?

- Herbicides, like 2,4-D, have residual effect, which can last for 2 years.
- The residual effect can damage your crop.

2. Preparing the field

- a) Field preparation should begin 2-3 weeks before transplanting.
- b) Base fertilization & Plowing:
 - i) Before plowing, apply up to 250Kg DAP or NPS per Hectare (25kg per 1000m²).
 - ii) First, apply the fertilizer to the field and then plow the land at least twice, in 2-4 days intervals.
 - iii) Plowing should be done in two directions - horizontally and vertically.
- c) After plowing break clods and big soil lumps to make a flat, uniform textured soil.



* DAP can be replaced by NPS (19-38-0-7)

Why?

- DAP or NPS base fertilization is important for providing Phosphorus (P) to the young plants.

3. Preparing beds and furrows

a) How to determine plant population:

The density of the plants will directly affect their productivity. As a general guideline, it is recommended that the plants will densely fill the row (plants touching each other), leaving a sufficient space between rows for sunlight and air flow.

Generally -

Tomato production requires 1,500-1,700 plants per 0.1H.

Pepper production requires 3,500-4,000 plants per 0.1H.

b) How to determine correct spacing:

Spacing should be determined according to soil type and environmental conditions, as well as the variety. Strong varieties need more spacing than compact ones. Please consult your local expert for the correct spacing for your plot.

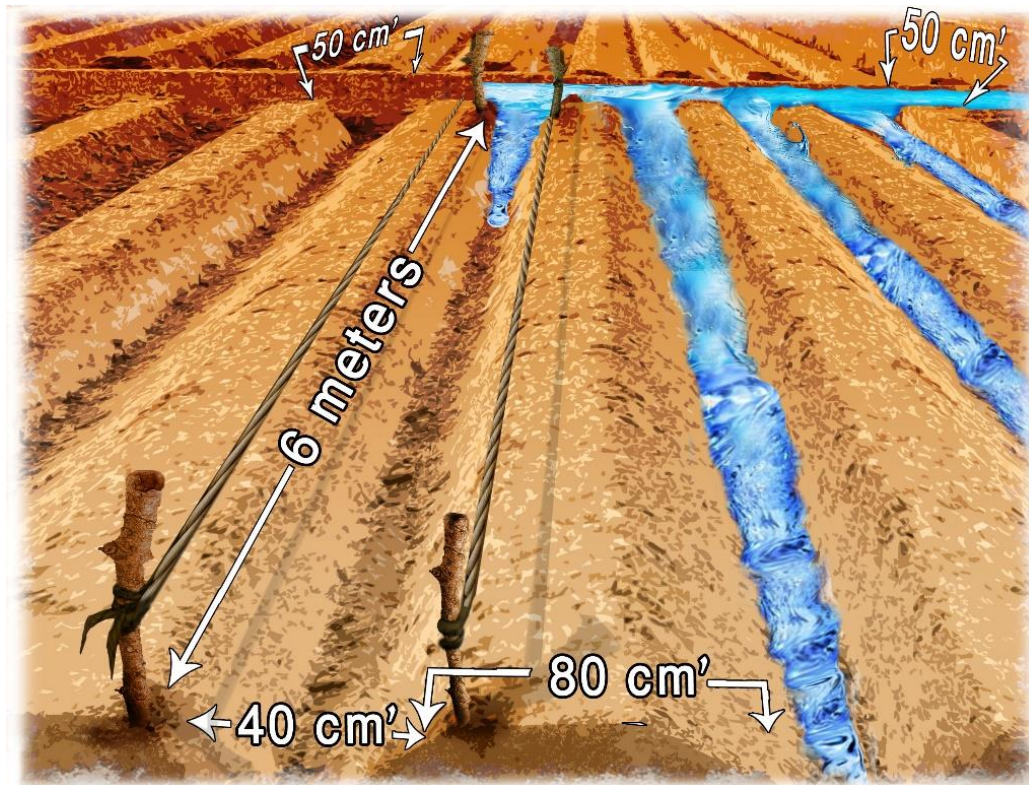
Tomato spacing (example)

- a) For 1.2 m spacing, prepare two measuring sticks (Chikal): 80cm and 40cm long (Adjust stick length if you need different spacing).
- b) Mark distances of 80cm for beds and 40cm for furrows on both sides of the field.
- c) Using a rope, mark the furrows and beds as shown in the figure.
- d) Using a shovel, pile the soil from the furrows onto the beds.
- e) Level the soil on the beds.
- f) Furrows should be 20-30cm deeper than the beds (depending on soil type and water source).
- g) Dig the main furrows every 6 meters. Main furrows should be 50cm wide.
- h) Irrigate the field 3 days before transplanting.

More examples:

- Strong tomato varieties (such as ShantyPM) – 1.3m.
- Compact tomato varieties (such as Chibli) – 1.0m.
- Strong pepper varieties (such as Amando) – 1.0m.
- Compact pepper varieties (such as Srenade) – 0.8m.

Tomato beds and furrows preparation (example)



Why?

- The size and spacing between the furrows allow efficient use of the water by the plant roots.
- Spaces between the plants are important to enable each plant to get good exposure to the sun
- Spaces are also important to avoid transfer of diseases from plant to plant.

4. Transplanting

- a) Do not leave the seedlings in direct sun and keep them well irrigated until transplanting them in the field.
- b) Before transplanting, prepare small holes to mark the spacing between the plants.
- c) Spaces between plants in the row should be 50-60cm for tomatoes and 20-40 cm for hot peppers. Consult your local experts regarding plant density.
- d) Plant all the seedlings on the same side of the bed, slightly above the water line, about two thirds of the height from the bottom of the furrow.
- e) While transplanting, the soil must be moist but not too wet.
- f) Transplant only in the late afternoon. Do not plant in hot weather.



Why?

- The seedling roots are small and placing them slightly above the water line will enable them to reach the water.
- Do not plant too low, since direct contact with the water will damage the plant and may cause diseases and rotting.
- Do not plant too high, since the small roots will not reach the water.
- When the plant grows, you will need to shift the beds (as described on page 15).

g) Plant only the root plug. **Stem and leaves should not touch the soil.**

Take care not to plant too deep



Why?

- The roots should be in the soil and the plant stem should be outside the soil.
- Do not cover the stem with soil: it can cause diseases and rotting of the stem.

h) Press the soil around the seedling



Why?

- Pressing the soil is needed to make sure there is no air trapped around the roots.
- Trapped air causes damage the roots.

5. Field management (Tomato and Hot Pepper)

- Immediately after transplanting, irrigate the plot.
- Supplement irrigation using water cans, to make sure each plant receives enough water.
- Repeat the irrigation with the water cans once a day, for 3 days.
- After 3 days, start irrigating in furrows and manage the field according to table 1 below.

Table 1 - Recommended schedule for irrigation, fertilization and field management

Week (from planting)	Watering (times per week)	KCl (Potash) (Kg / 1000 m ² / week)	UREA (Kg / 1000 m ² / week)	Activities in the field *
1	1-2	2	1.5	
2	1-2	2	1.5	
3	1-2	3	2.9	Prepare for trellising
4	1-2	4.7	3.1	Remove first flower in pepper
5	2-3	8	4	Install trellising
6	2-3	8	6.5	Shift Beds
7	2-3	11	8.5	Add 2 nd layer of rope for trellising
8	2-3	11	8.5	
9	2-3	11	8.5	Add 3 rd layer of rope for trellising
10	2-3	11	8.5	
11	2-3	11	8.5	Add 4 th layer of rope for trellising
12	1-2	8	6	
13	1-2	8	6	Start of Harvest
14	1-2	8	6	Harvest
15	1-2	7	6	Harvest
16	1-2	7	4	Harvest
17	1-2	7	4	Harvest
18	1-2	7	0	Harvest
19	1-2	0	0	Harvest ends
20	1-2	0	0	Collect equipment, Clean plot, Plow and Plan the next crop
* Constant actions in the field:				
<ul style="list-style-type: none"> Look for pests and diseases and spray with chemicals according to need. Check chemical treatment efficiency 3 days after spraying. Remove weeds. Keep the beds and furrows in proper condition. Cultivate the soil before irrigating, to improve irrigation efficiency. 				

Important notes:

- Using Potassium Chloride (KCl) combined with Urea, especially in cold weather, may cause yellowing and burns (scorches) to leaves. The yellowing symptoms may resemble fertilizers' deficiencies.
- KCl may cause the soil to become salty and the risk increases when using it repeatedly in the same plot (risk of long-term soil salinity).
- For Potassium application it is recommended to use Potassium Nitrate (KNO₃), which includes some Nitrogen content and does not bare the risk of long term salinity since it does not contain Chloride (Cl). When using KNO₃, reduce 13% of the amount of Urea applied.

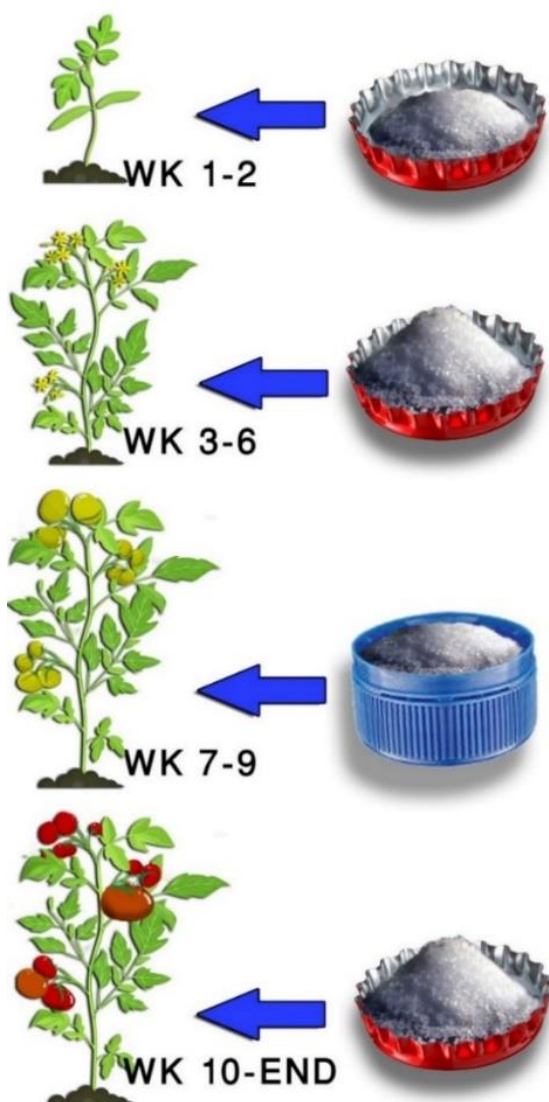
6. Using fertilizers

- Apply Urea and Potash according to the schedule in table 1 above.
- Irrigate the plot immediately after fertilizing.

In case you cannot use table 1 for applying the needed fertilizers per week, add each fertilizer (Urea and Potash) as described below for single plant application (see also figure below for more details).

Single plant application:

- Weeks 1 and 2 – half a cap of Coca Cola bottle per plant from each fertilizer.
- Weeks 3 to 6 (flowering) – a full cap of Coca Cola bottle per plant from each fertilizer.
- Weeks 7 to 9 (fruiting) – half a cap of one liter water bottle per plant from each fertilizer.
- Week 10 to end of harvest – a full cap of Coca Cola bottle per plant from each fertilizer.
- You can reduce the amount of fertilizer as the yield is getting lower.



Important notes:

- Adjusting the fertilizers amounts along the season, is highly important. The difference in soil types, varieties, plot history, and the desired outcome should be accounted for to optimize the result. Check your crop frequently for Deficiencies / Excesses of fertilizers to identify problems (see illustrating pictures below).
- Table 1 provides general recommendations. It is highly recommend to consult with your expert and adjust your application program.

7. Fertilizer application

- a) Place the fertilizers on the side of the bed between plants; at least 20cm away from the plants (see illustration below).

Make sure that fertilizers do not come in direct contact with any part of the plant.

- b) Irrigate immediately after fertilizing.

Why?

- Fertilizers should be applied in the middle between every two plants.
- Direct contact of the fertilizer with plant parts can cause burning damage.
- Irrigating is needed to dissolve the fertilizers and make them accessible to plant roots.

Step 1 - Using a stick, create 5-10 cm deep slots on the side of the bed between the plants.



Step 2 – Apply fertilizer into the slot.



Step 3 - Cover the fertilizer with soil.



Step 4 - Irrigate immediately after fertilizing.



Symptoms of Nutrient deficiencies in Tomato

Lack of Nitrogen (N)



Nitrogen (N) deficiency:

Chlorosis symptoms appear on the leaves. A light red cast can be seen on the veins and petioles. Older mature leaves gradually change from green to pale green. As the deficiency progresses, these older leaves become uniformly yellow (chlorotic). The young leaves at the top of the plant maintain a green but paler color and tend to become smaller.

Lack of Phosphorus (P)



Phosphorus (P) deficiency:

Symptoms are not very distinct and difficult to identify. They can appear as necrotic spots on the leaves, and the plants can be dwarfed or stunted. Phosphorus deficient plants develop very slowly, showing a distinct purpling of the stem, petiole and the lower sides of the leaves. Under severe deficiency conditions, blue-gray shine can appear on leaves.

Lack of Potash



Potassium (K) deficiency:

Symptoms can appear as marginal necrosis (tip burn), or necrosis in the interveinal spaces between the main veins along with interveinal chlorosis.

Symptoms of Nutrients deficiencies in Pepper

Lack of Nitrogen (Urea)



Nitrogen (N) deficiency:

Plant development gradually slows down. Gradual drying, beginning at leaf margins, of the area between the lower leaf veins. The petioles bend and hang downwards, parallel to the stem. The plant develops few flowers and fruit setting is poor. The fruit receptacle is thin, and the ovary is small.

Lack of Phosphorus



Phosphorus (P) deficiency:

The plants display limited growth. The leaves are hard and brittle to touch. Flower and fruit formation is very low. The fruit is underdeveloped, with a thin receptacle, and very few seeds. The root system is undeveloped.

Lack of Potash



Potassium (K) deficiency:

Yellow chlorotic spots appear between leaf veins, starting from lower leaves. The veins do not change color. Later, the chlorotic spots become lighter (this can be seen mainly in the upper parts of the plant). There is little fruit setting, and the fruits are smaller than usual.

Source – Haifa Chemicals



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8. Furrow Shifting

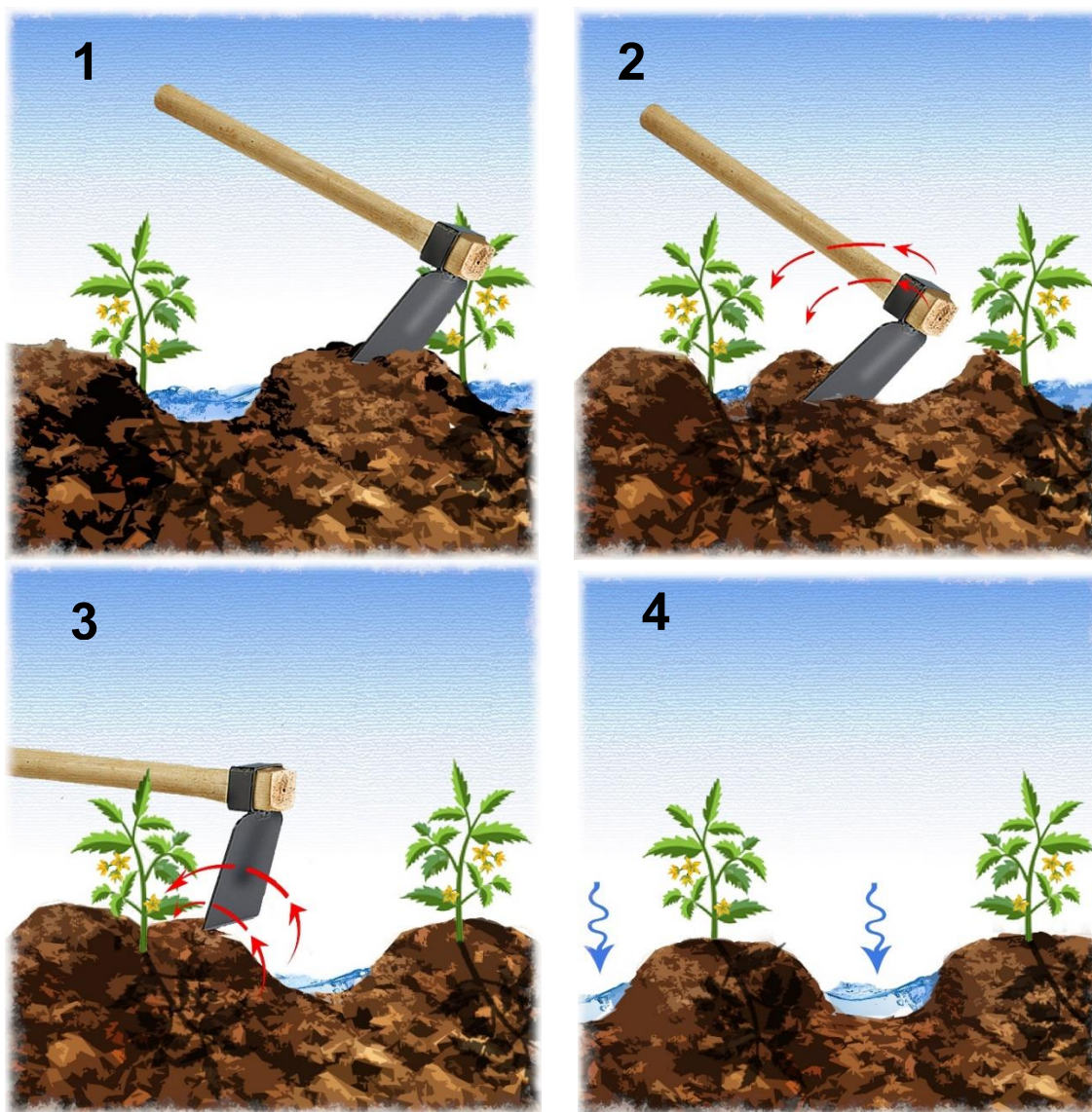
About 5-6 weeks after transplanting, when the plants have been fully established, you should shift the furrows away from the plants. The new furrows should be between the rows (see illustration below).

Carefully move about half of the soil from each bed to fill the existing furrow, creating a new furrow in the middle between the rows.

Be careful not to damage the roots of the plants while doing the work. The size of the roots is usually the same as the size of the plant.

Why?

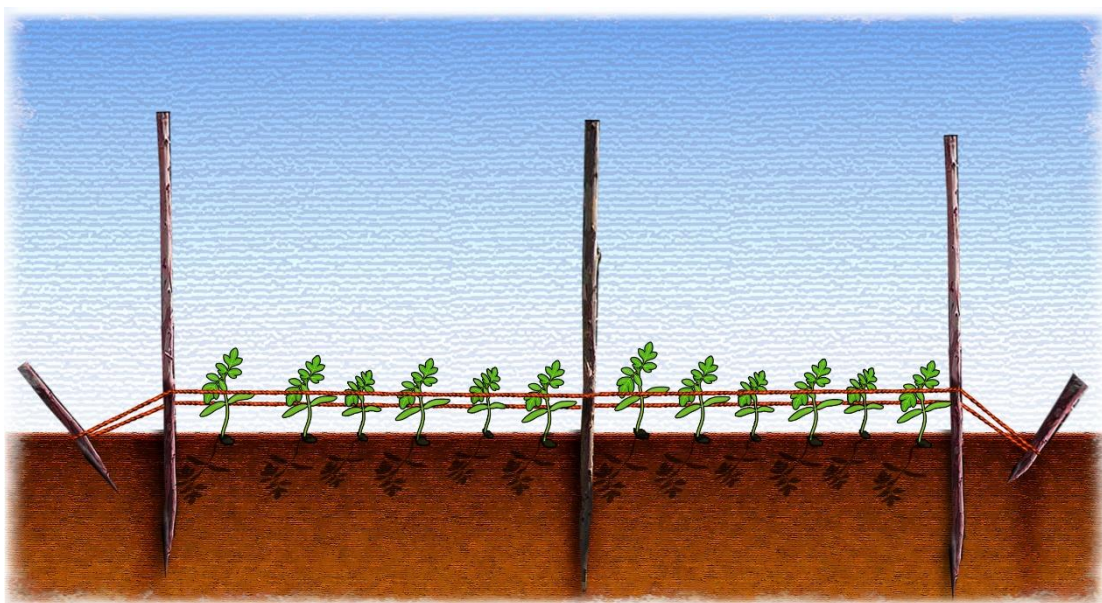
- Shifting the furrows is needed to avoid direct contact of the water with the plant.
- Direct contact with water damages the roots, stems, leaves and fruits.



9. Trellising

Tomato

- For each 6-meter bed use 3 poles, (you need about 500 poles for 1,000m² plot).
- The poles should be 2 meters long.
- In each bed put two poles on both ends and one pole in the middle. A pole every 3 meters, 6 plants between poles.
- Make sure to align the poles with the plants.
- Insert Poles half a meter deep into the ground.
- At the end of each bed, insert a 50 cm long peg, in a 45° angel, to support the poles, as the plants will get larger and heavier.
- On each side of the plants, stretch a rope line and secure it to all three poles. All the plant branches should be between the two rope lines. (See figure below).



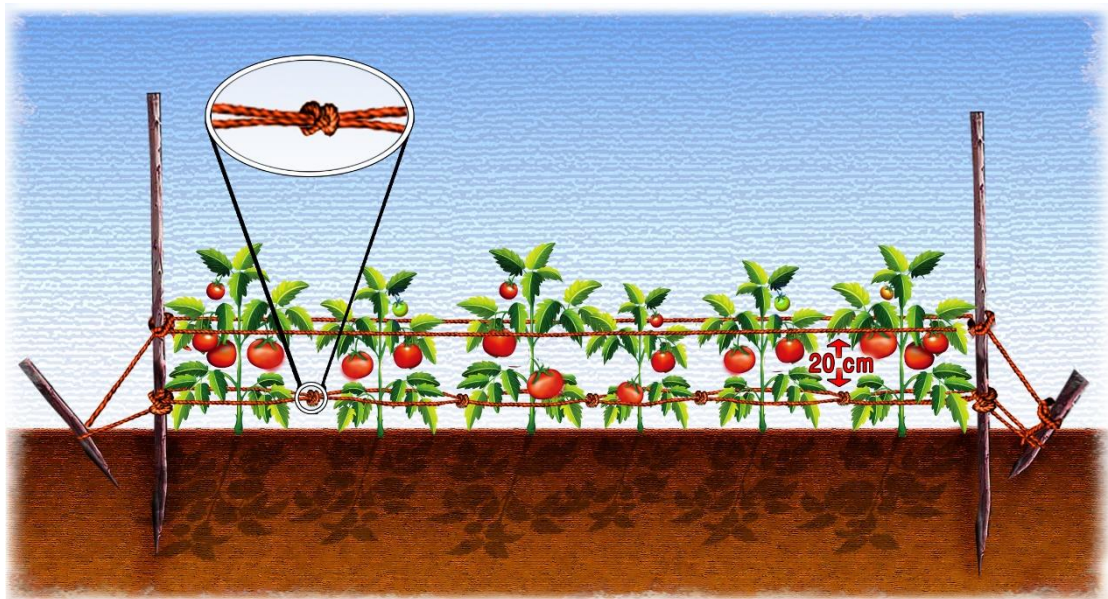
Why?

- The fruit load of high quality tomato varieties is very heavy and the plant needs mechanical support.
- Trellising will reduce direct contact of leaves and fruits with the water and the soil that can cause rotting and increase development of diseases.

Note: some varieties may not require trellising – please consult with your local expert.

- h) Add additional levels of trellising every 20-30cm.
- i) When adding a level, tie the rope lines of the previous level between the plants for additional support.

Repeat this action every several days, as the plant produces new branches.



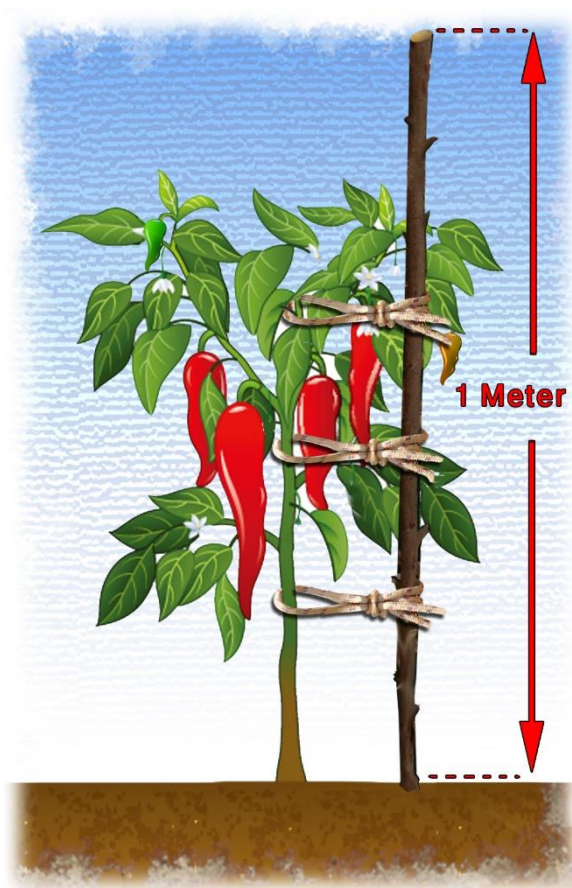
Important Note:

- It is very important to avoid breaking stems and branches while trellising. Breaking damages the plant and increases diseases infections.
- **Always remember:** “stem up – branches out” - the stem of the tomato should stay between the 2 ropes, while the branches should laid gently on top of the rope, facing out.

Hot pepper

For pepper, trellising is less critical. We recommend supporting pepper plants by placing a 1m stick next to each plant and tying the plant to the stick using a soft rope.

To improve plant vigor it is recommended to remove the first flower (only one flower per plant) from each of the plants as early as possible.



Why?

- Hot pepper does not require trellising to support the weight of the fruits.
- However, improved varieties tend to be larger than local ones, and might break if plants are not supported.
- Removing the first flower from the pepper plants improves the plant vigor.

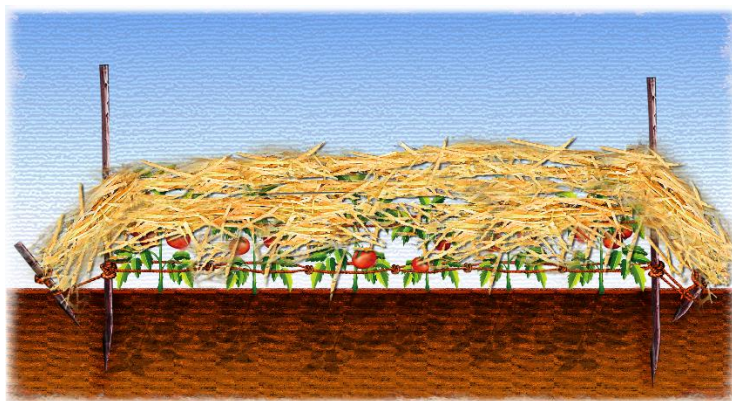


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10. Coping with frost

Tomato and pepper plants are very susceptible to frost damage. Sub-zero temperatures will affect both plant parts and fruits, resulting in significant damage (up to complete loss) to the crop. There are several ways that may help to reduce frost damage:

- a. **Irrigation** – well-irrigated crops have a better chance to cope with frost. If there is a frost-warning, make sure your field is well irrigated the day before.
- b. **Covering** the top parts of the plants with straw.



- c. **Fire and Smoke** – burn smoke producing material, such as used tires or damp straw near the field. Fires should be lit up-wind, so that the smoke will cover the plants.



Why?

- Cold air and frost tend to accumulate in lower areas and around the plants, and cause damage to the plants.
- Irrigation before a frost warning will add vigor to the plants and help reduce the frost damages.
- The straw covers the top part of the plants and absorbs some of the frost.
- The heat and the smoke from the fires will cause movement of the air above the field and will reduce frost accumulation around the plants.

11. Safe spraying for pest control

a) Safety guidelines

- i) Do not inhale the pesticides.
- ii) Cover your mouth and nose with a professional spraying mask.



- iii) Wear long sleeved shirt, long trousers, shoes, and cover your head and neck.
- iv) Wear gloves also when preparing the chemicals.
- v) Make sure other people are not present in the field while the field is being sprayed and 2-3 days after spraying (according the chemical label).



Why?

- Most pesticides are toxic to humans.
- The person who sprays should protect himself.
- Other people should not be present in the field while the field is being sprayed, and during 2-3 days after spraying (according to chemical label).



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b) Correct spraying

- i) Make sure you spray from above, from the sides, from beneath and inside the plant, to get full plant coverage (full shower).
- ii) Apply the amount recommended by the manufacturer on the chemical's label.



Why?

- Pests and diseases are developing on both sides of the leaves and inside the plant.
- Chemicals should reach all plant parts.

c) Spraying at harvest time

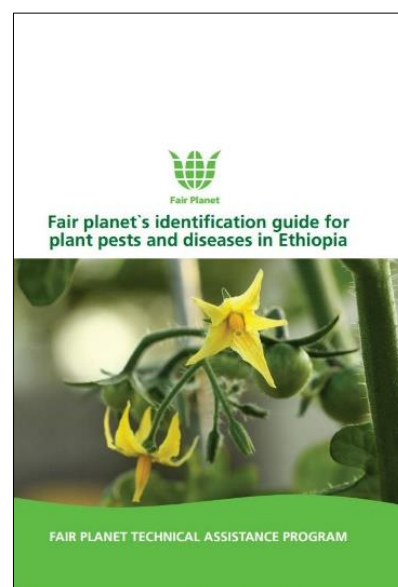
- i) Spray only after harvesting all the ripe fruits.
- ii) Wait 1-7 days before harvesting.
- iii) The number of days between spraying and harvesting is indicated on the label of the chemical or on the chemical's package.

Why?

- Some chemicals are toxic to humans even after 7 days!
- Always follow the instruction on the chemical label.

12. Pest Management

- a) Monitor the plants daily, checking leaves, stems, flowers and fruits.
- b) Consult with your Kebele Development Agents and the experts from your woreda Office of Agriculture about pest or disease symptoms you observe in your field.
- c) We strongly recommend approaching the experts with a sample of the infected plant (leaves, stems or fruits).
- d) Some common pests and diseases are described in our Pest Identification Guide available from your local experts and the Fair Planet team.



13. Harvest and Storage

We recommend harvesting **tomatoes** before they are too ripe and red, when the fruit color turns to orange / light red.



Why?

Tomatoes

- Over-ripe fruits in the field attract pests and birds.
- Delayed harvest creates high fruit load on the plant.

Note: improved varieties have long shelf life and can thus be harvested red, maintaining their shelf life. If prices in the market are low, you can delay the harvest by several days without losing quality.

Harvest **green hot peppers** at "mature green" phase, when seeds are mature. You will be able to feel the seeds through the wall of the fruit when pressing it. Harvesting immature fruits will result in low pungency and yield reduction.

Why?

Pepper

- When seeds are mature, the fruit is pungent.

After harvest, vegetables should be stored in a shaded space that is cool and dry. Do not cover the vegetables with plastic, to allow ventilation. Storage of vegetables in suitable conditions can prolong their shelf life. Store in open, well-aired containers without plastic covers, and sort fruit of different ripening stages into separate containers. These conditions may allow you to store vegetables in good quality for as long as a week.



Why?

- Covering the fruits will speed ripening, shorten shelf life and damage the crop quality.

We Wish You Success!



Fair Planet Ethiopia