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AVRDC – The World Vegetable Center



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Introduction

Raising healthy seedlings under good nursery management is an important part of successful vegetable production, especially for tomato, pepper, eggplant and other crops that are commonly transplanted.

The aim of this guide is to familiarize tomato growers with good nursery management techniques for raising healthy tomato seedlings and to promote adoption of healthy seedling preparation methods to enhance tomato production.

Nursery facilities

Tomato seedlings can be raised in facilities ranging from simple shelters to sophisticated greenhouses. All structures should protect seedlings from heavy rainfall, low ($\leq 5\text{ }^{\circ}\text{C}$) or high ($\geq 35\text{ }^{\circ}\text{C}$) temperatures, intense sunlight, high relative humidity, and exposure to pests and diseases.



Figure 1. A moderately simple nethouse with raised benches and concrete floor for producing vegetable seedlings in plastic plug trays. When raising tomato seedlings, a black shade net or locally available shade mats can be set up over the trays to reduce sunlight and lower the temperature before seedlings emerge.

Moderately simple nethouses (Fig. 1) or net tunnels (Fig. 2) covered with 50- to 60-mesh nylon netting are highly recommended to prevent insect pests, such as whiteflies and aphids, from transmitting viruses to young tomato plants. If 50-60 mesh is not available, 32-mesh netting will also prevent many pests from entering.



Figure 2. Simple net tunnels can be set up by covering locally available bamboo sticks or metal hoops with 50-mesh nylon netting.

Tomato seeds germinate best in the dark. After sowing, shade netting (50% light penetration) can be used to cover the tunnels, or be placed inside the nethouse (Fig. 1) under the plastic sheet to enhance seed germination. In the wet season, plastic sheets can be used to cover the tunnels to protect seedlings from rain.

Obtaining seed and amount needed

Choose locally appropriate tomato varieties and purchase healthy, recently produced seeds from a reliable source. The amount of seed required to produce enough seedlings for one hectare is listed in Table 1. For higher-priced hybrid varieties, the amounts in Table 1 are recommended, but for lower-priced open-pollinated varieties, the grower may wish to plant extra seed to ensure plenty of seedlings are available. Depending on the seed cost and germination rate, the grower may wish to plant 15-100% additional seeds to ensure enough seedlings are ready for planting at the optimal time.

Table 1. Amount of tomato seed required to plant one hectare (based on plant densities at AVRDC)

Type of tomato		Number of seeds/g	Planting distance between rows and plants (m)	Seeds needed per ha planting (g)	Plants/ha
Fresh market	Indeterminate/ Determinate	250-300	0.75 x 0.4-0.5	100-150	26,000- 33,000
Cherry	Indeterminate	450-550	0.75 x 0.5	65-80	26,000- 32,000
	Semi-determinate/ Determinate	450-550	0.75 x 0.5	65-80	26,000- 32,000
			1.5-2.1 x 0.5	25-35	20,000- 22,000
			2.1-2.4 x 0.6*	18-20	6,900- 7,900
Processing	Semi-determinate/ Determinate	250-300	1.5 x 0.3-0.4	75-105	16,000- 23,000

*For better ventilation and ease of operation, and extending the harvesting period (Fig. 3, left picture).

Seedling preparation

The choice of seedling raising methods depends on planting areas, convenience of operation, and flexibility. Seedlings grown in beds or seedboxes/trays suffer from root damage when the plants are pulled apart for transplanting; this can slow down subsequent growth. Seedlings grown in individual containers are healthier and more vigorous (Fig. 3, right picture) than those grown in beds or seedboxes/trays. Seedlings usually emerge within 3-5 days at optimal soil temperatures of 20-30 °C. It is highly recommended to raise all seedlings under protected structures such as simple nethouses or net tunnels before they reach the hardening stage.



Figure 3. A layout requiring fewer seedlings: Tunnel cultivation for cherry tomato (photo by Chen Ming-che) (left). Tomato seedlings raised in plastic plug trays are vigorous and uniform (right).

Seedling container or plug tray method

This method involves raising seedlings in separate pots/containers or plastic/Styrofoam plug trays to provide adequate nutrients and growing medium for healthy root development and seedling growth. Seedlings raised in individual containers or plug trays normally have a 100% establishment rate in the field since they are transplanted with the medium-root block (Fig. 4). This prevents injury to the roots and transplanting shock to the seedlings.



Figure 4. Tomato seedlings grown in pots or plug cells can be transplanted with the medium-root block (red circle) to avoid root damage and transplanting shock.

Seedling containers: Containers made of biodegradable materials such as rolled banana leaves or other locally available materials, paper pots, perforated plastic bags 5-7 cm wide and 10 cm long, thin plastic pots 5-7 cm in diameter, or commercial plastic/Styrofoam plug trays can be used for seedling production (Fig. 5-7). All containers, pots or cells must have a hole in the base for draining excess water. Seedling containers should be fully cleaned and exposed to sunlight or disinfected with 1% solution of chlorine bleach before and after use.

Growing medium: Fill the containers or plug trays with a medium that drains well, such as commercial potting soil, or a mixture of locally available materials such as soil, sand, well-decomposed compost and rice hulls in a 1:1:1:1 ratio (Fig. 8). Other good mixtures include decomposed cocodust, cow dung and soil in a 2:1:1 ratio (Fig. 9), or grated coconut husk and soil in a 1:2 ratio (Fig. 10), to facilitate the emergence of seedlings.



Figure 5. Different containers are used to raise tomato seedlings: **(top & bottom left)** AVRDC uses 72-cell plastic plug trays with 4 cm deep and 4.5 cm wide cells; **(top right)** Styrofoam plug trays are used in some countries such as Vietnam; **(bottom right)** locally available plastic cups are used in Bangladesh.



Figure 6. Containers made of biodegradable materials: **(left)** rolled banana leaves in the Philippines (photo by Carmelito R. Lapoot); **(right)** rolled leaves of La'a, a common plant in the Solomon Islands (photo by Suz Neave).



Figure 7. Plastic pots **(left)** or plastic bags **(right)** filled with potting soil can be kept in plastic or wooden trays for easy transport.



Figure 8. Components of a potting mixture used at AVRDC for raising tomato seedlings (soil: sand: compost: rice hulls=1:1:1:1).



Figure 9. Farmers use decomposed cocodust, soil and cow dung (2:1:1) for raising tomato seedlings in Bangladesh (photos by Zahir Ullah).



Figure 10. Farmers grate coconut husks (**left**) and mix them with soil (inside the plastic bucket) (**right**) in a 1:2 ratio for raising vegetable seedlings in the Solomon Islands (photos by Pitakia Tikai).

Medium sterilization: The medium should be steamed at 120 °C or 45 minutes, or watered and heat-sterilized in covered soil sterilizers for 6-12 hours, or sterilized through solarization for 3-4 weeks to minimize levels of soil-borne pathogens, nematodes and insect pests. Please refer to the soil sterilization instructions under **Seedbed method** on page 12.

Sowing, watering and thinning: If there is a risk that the seeds will be attacked by fungal pathogens or insect pests, consult with local extension agents for their recommendations on proper seed treatment before sowing. Sow 2 seeds per pot/cell, cover the seeds with fine compost or potting mixture (Fig. 11), and water gently with a fine sprinkler (Fig. 12, left picture). Place the pots or

plug trays on top of bricks or benches in a net tunnel or nethouse. When 1-2 true leaves appear, thin out excess seedlings and keep only one seedling per pot/cell (Fig. 12, right picture). Careful water management is important. Sprinkle seedlings with water daily in hot and dry weather or once every two days in cool weather to provide sufficient moisture for growth. Overwatering seedlings is common in cool weather. Lift a few seedling trays to test whether they feel too heavy (waterlogged) or too light (under-watered), and adjust watering if necessary.



Figure 11. Cover the seeds with potting mixture (**left**) or fine compost (**right**) after sowing.



Figure 12. After sowing, water gently with a fine sprinkler (**left**); after sprouting, thin out excess seedlings (red circle) and keep only one seedling per cell (**right**) when 1-2 true leaves appear.

Seedbox or tray method

Seedlings raised in seedboxes or trays are best kept in a sheltered place such as a net tunnel or nethouse, especially during unfavorable conditions. Seedboxes or trays are also convenient for transporting the seedlings to distant fields.

Size: Use 10-12 cm deep and locally available wooden or plastic seedboxes or trays (Fig. 13) of convenient size with drainage holes in the bottom.

Growing medium and sterilization: The same growing medium described for the seedling container or plug tray method can be used. Sterilize the medium as recommended. Place the seedboxes or trays on top of bricks, wood blocks or benches to provide good drainage, especially during the wet season.



Figure 13. Wooden seedboxes or plastic trays for raising seedlings.

Sowing and watering: Prepare 0.5-1 cm deep furrows 6 cm apart, or 0.5-cm-deep holes 5 cm apart in seedling boxes or trays, and sow 2 seeds per hole. Cover the seeds with fine compost or rice hulls (Fig. 14). Use a fine sprinkler to water daily in the hot dry season or every two days in cooler weather.

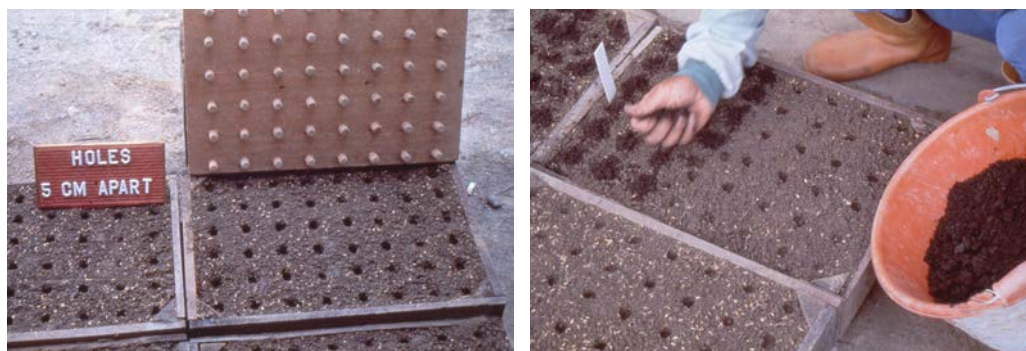


Figure 14. A dibbling board can be used to make 0.5 cm deep holes (**left**); sow 2 seeds per hole and cover the seeds with fine compost (**right**).

Thinning: Pull out excess seedlings 2–3 days after 1-2 true leaves appear so that remaining seedlings are about 5 cm apart, or maintain only one vigorous plant per hole to provide sufficient soil space for root development and plant growth (Fig. 15).



Figure 15. Remove excess seedlings soon after the appearance of 1-2 true leaves.

Seedbed method

Seedlings are raised in beds when large quantities of seedlings are needed and the aforementioned methods are not available. However, seedlings may suffer from root damage when the plants are pulled out of the seedbeds for transplanting (Fig. 16). Damage to the roots will delay growth or cause the seedlings to die.



Figure 16. Tomato seedlings raised on seedbeds are pulled out for transplanting after thorough watering, in Jessore, Bangladesh (photo by Zahir Ullah).

Location and seedbed size: Choose an open, sunny and well-drained area not recently planted with a solanaceous crop (such as tomato, pepper, eggplant, potato). Incorporate well-decomposed and sieved compost or farmyard manure at a rate of 2 kg/m² into beds. Form raised seedbeds 15 cm or higher and 80-100 cm wide to improve drainage (Fig. 17). At least 150 m² of seedbed area is needed to raise enough seedlings to plant one hectare.



Figure 17. Raised seedbeds. The bed on the left is covered with a transparent plastic sheet to sterilize the seedbed soil through solarization.

Soil sterilization: Solarization is an easy, safe and cost-effective way to sterilize the soil and produce healthy seedlings. To solarize the soil, follow these steps:

- (1) Apply water to moisten seedbed soil
- (2) Cover the soil with transparent plastic sheets for 3-4 weeks (bury the edges of the sheets in the soil) (Fig. 17)
- (3) After 3-4 weeks, remove the plastic sheets and plough the soil
- (4) About 2-3 days later, level the soil and sow the seeds

Solarizing the seedbed soil before sowing is recommended to kill many insect pests and pathogens as well as weeds, to prevent seedling damping-off, and to reduce soil-borne diseases. The best time for solarization is during the dry season with high temperatures.

Net tunnels: Set up simple net tunnels with 50- to 60-mesh nylon netting (or at least 32-mesh) over the seedbeds to protect seedlings against rain, sun and insect pests (Fig. 2).

Sowing: Sow the seeds evenly in rows 5 cm apart and 0.5 cm deep at a rate of 750–900 seeds/m². Cover the seeds in the rows lightly using either soil from the bed or finely sieved compost. Or sow one seed per hole into the seedbeds prepared with a wooden teeth bar (Fig. 18). Cover the net tunnel with locally available shading mats until seedlings emerge.



Figure 18. Planting holes 0.5 inches deep prepared by wooden teeth bar in rows 2 inches apart (left) for tomato seedling raising; one seed per hole was sown (right) at the commercial vegetable nursery in Abdulpur village of Jessore, Bangladesh (photos by Zahir Ullah).

Watering: Water the seedbed daily during the hot and dry season by using a fine sprinkler to maintain optimum moisture for healthy seedling growth. In the cool season, watering can be carried out once every two days. Avoid excessive watering.

Thinning: Remove the shade mats after the seedlings emerge. Allow seedlings to grow about 5 cm apart within the row. Thin out the excess plants. This is usually done within 2-3 days after the first true leaf has appeared (about 5-7 days after sowing). Excess seedlings can be transplanted to trays or individual containers for transplanting to the field later, especially when expensive seeds such as hybrid varieties are used.

Seedling management

Damping-off control: Young seedlings may develop a sunken, brown, necrotic lesion near the soil line due to fungal infection. If the lesion girdles the stem, the seedling collapses and soon dies (Fig. 19). To prevent this problem, apply terrazole (etridiazol 35% WP) at 0.25 g/500 ml after thinning. If damping-off symptoms develop further, apply terrazole 1-2 more times during the seedling stage.



Figure 19. Symptoms of tomato damping-off: the necrotic, brown lesion girdles the stem and the seedling collapses (red circle) and soon dies.

Fertilization: Around 7-10 days after thinning, if the seedlings seem thin or the leaves turn a pale yellow-green color, especially on the older foliage (Fig. 20), apply one of the following treatments once to the seedlings:

- Option 1)** 0.5% ammonium sulfate solution (5 g ammonium sulfate dissolved in 1 liter of water)
- Option 2)** 0.25% urea solution (2.5 g urea dissolved in 1 liter of water)
- Option 3)** 0.1% foliar nitrophoska solution (1 g dissolved in 1 liter of water)

Apply again one day before transplanting. Do not over-apply nitrogen or the plants will grow too tall and thin (Fig. 20, right picture, left plant). Monitor seedling growth; if the seedlings grow too rapidly before transplanting, apply less fertilizer.



Figure 20. Apply nitrogen solution when the older leaves of tomato seedlings turn a pale yellow-green color (left). Excessive nitrogen application or weak sunlight makes tomato seedlings tall, thin and spindly/leggy (left plant) rather than stocky, strong and sturdy (right plant) (photo by Vanna Liu) (right).

Hardening: When the seedlings have 4 true leaves (around 20-25 days after sowing), harden the seedlings by slightly reducing the water supply. Around 6-9 days before transplanting, slightly reduce watering, remove the netting and expose the seedlings to strong sunlight so that they will be stocky and sturdy (Fig. 21). Thoroughly water the seedlings 12-14 hours before transplanting them to the field.



Figure 21. Healthy and vigorous tomato seedlings raised in pots **(left)** (photo by Chen Ming-che) and plastic plug trays **(right)** that are ready for transplanting.

Features of a good tomato seedling



- ☑ At least 4-5 true leaves (about 4 weeks old)
- ☑ Around 12-15 cm tall
- ☑ Short internode length
- ☑ Vigorous and stocky
- ☑ No pest & disease symptoms
- ☑ No flower buds or flowers

References

Chen JT. 2005. Tomato cultivation and management. Taiwan Agriculture Encyclopedia (Crop Edition - 2), 3rd ed., p. 517-532. Council of Agriculture, Executive Yuan, Taipei, Taiwan (in Chinese).

Hanson P, Chen JT. 1998. Cultivation & seed production of tomato. Training workshop on vegetable cultivation and seed production technology.

Hanson P, Chen JT, Kuo CG, Morris R, Opeña RT. 2000. Suggested Cultural Practices for Tomato. AVRDC publication #00-508.

Lal G, Chen Y-M, Midmore DJ. 1992. Vegetable nursery management techniques. AVRDC publication #92-390.



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