Food and Agriculture Organization of the United Nations

Technical Fact Sheet

Vegetable seedling production in trays

3

Introduction

Sowing vegetable seeds in trays is a popular practice among farmers around the world, as it allows for the production of better, higher quality plants and crops, with increased yield potential. Key advantages of producing seedlings in trays include:

- efficient use of seeds;
- compact, uniform and vigorous plants;
- fewer pests and diseases;
- optimum growth of root systems;
- ease of portability and transport across long distances; and
- flexibility to transplant at any time of the day (due to reduced risk of stress).

At the same time however, the use of this technology requires higher investment, good management skills and knowledge of specific good practices and techniques for success.

Nursery structure

The nursery is where the seedlings grow until they are transplanted. Different types of structures may be used as nurseries – from simple, low-cost tunnels covered with plastic or netting (to protect from rain and insects), to expensive, automated greenhouses. High-quality seedlings can be produced in both cheap and expensive nurseries, as their quality depends largely on good management practices. However, the following general recommendations may be considered for ensuring an optimal nursery environment:

- The nursery should be located far from established crops, so as to avoid the cross-over of pests and diseases.
- Trays should be placed on racks or tables, and should never touch the ground.
- Simple racks or tables can be built to hold the trays, using narrow shafts of bamboo or wood, with some thick wire or metal frames to keep the trays in the air. This will ensure the seedlings' roots do not overflow, as this can result in damage to the roots when they are being transplanted out of their trays.

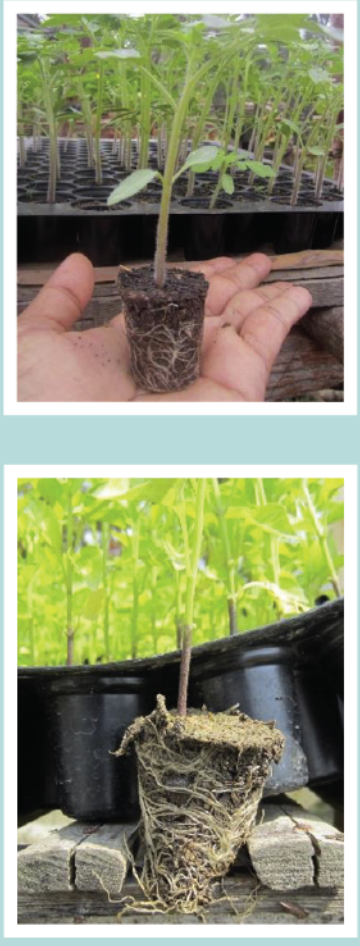

Figure 1. A compact seedling with a good root system

Trays

Many types of trays can be found on the market. They are classified by the shape of cell (square or round), the number of cells per tray, the size, and the materials they are made of. The most common trays are made of plastic and polystyrene.

Tray selection should be made based on the crop, as this affects the specific size of cell needed. Too many cells per tray will produce elongated, weaker plants, which will suffer greater stress during and after transplanting.

It is very important to clean and sterilize trays after each use. Any residue from plants or substrate should be washed away with water, and the trays should be sterilized with hot water or with products such as chlorine or iodine.

Crop	Cell diameter (cm)	Number of cells per tray
Lettuce and cauliflower	2-2.5	128 – 200
Cucumber, pepper and tomato	2.5	92 - 128
Melon , watermelon	3	68 - 92

Table 1. Recommended cell size and number of cells per tray fordifferent crops

Figure 2. Different types of nursery structures

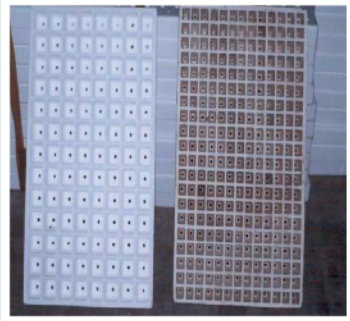

Figure 3. Polystyrene trays (avobe) and plastic trays (below)

Substrates

Commercial, ready-made substrates are composed of mixed materials such as peat, coconut fibre, vermiculite and perlite, in different combinations and proportions. They provide proper water retention along with good drainage. Some also incorporate fertilizer, and have adjusted pH values for use with different crops.

As an alternative to purchasing them ready-made, substrates can also be made from a mix of locally available materials including soil, compost, sand and rice husks. Care should be taken to ensure that a locally made substrate has the necessary water retention and drainage capacity. The proportion of soil to be used will depend on the texture, but contaminated soils and soils with too much clay should be avoided.

Locally made substrates must be sterilized using direct heat or steam. For efficient sterilization, the substrate should also be kept wet for three days beforehand, in order to activate pathogens (e.g. fungi, bacteria and nematodes) and weeds.

Substrate characteristics must also be considered for water and nutrient management of seedlings, as discussed in subsequent sections of this fact sheet.

The water management and the nutrition of the seedlings will depend on the characteristics of the substrate.

Sowing

Sowing may be manual or mechanized. When manual, efficiency will depend on the person doing the sowing, as patience, focus and hand coordination skills are essential.

The amount of seeds to sow depends on the total number of plants and the germination percentage. It is recommended to add an extra 10 percent for losses in the field, as in the following formula:

$$\textit{Seeds to sow} = \frac{\textit{Number of plants} \times 1.1}{\textit{Germination \%}} \times 100$$

Before sowing, the substrate should be wet enough to ensure the seed swells and germinates, but no more, as too much water may lead to diseases or cause a lack of oxygen in the root system.

Fill each tray properly and ensure there are no large gaps or air pockets, by applying light pressure to each cell once filled. Lightly tap the side of the tray to help the substrate settle. Once the tray is filled, it is important to mark the cells by making a small hole in the centre of the cell, about 2.5 times the size of the seed in depth.

Once the trays are ready, place the seeds in the holes in each cell. If using seeds that have a high germination rate, use one seed per cell; if using seeds with a low germination rate, use two or three seeds per cell. This should guarantee good seedling development, while also minimizing seed wastage.

As the final step in sowing, cover the seeds with a thin layer of substrate and then stack the trays one on top of each other, taking care to avoid overloading lower trays, and to separate each row of trays with wooden sticks or other spacers to ensure room for ventilation.

Germination chamber

The germination chamber is where trays are stored after sowing, and helps to increase uniformity across seedlings as they begin to grow. Various types of germination chamber can be used, ranging from simple black plastic bags to specialized rooms with temperature and humidity sensors. The goal is to keep the seeds in a dark place, at a certain level of temperature and humidity, without any air flow.

Trays must then be checked at least three times a day. If they are not checked daily, there is a risk of losing the investment in both seeds and time. Even a few hours of delay will result in elongated, weak and unusable plants.

Figure 4. Low-cost sterilization using heat

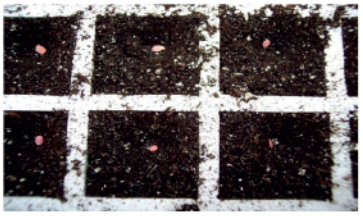

Figure 5. A seedling tray with one seed sown in the centre of each cell

Figure 6. Covering seeds with substrate

As soon as the first sprouts are seen, all the trays must be removed from the germination chamber and placed in the nursery, where they will grow until it is time for transplanting.

Grafting

Grafting is a technique that consists of joining two plants of the same species or family, to make a new plant with different characteristics. The part that forms the root system is called the rootstock, and provides resistance to nematodes and/or soil-borne diseases. The upper part is called the scion, and is chosen for its desirable fruit characteristics, as demanded by the market. Grafting techniques therefore result in plants that have greater tolerance to pests, diseases, salinity and drought, thus reducing the use of pesticides, improving water and nutrient absorption, and increasing yields.

For grafting to succeed, strict control of temperature and humidity is required during the union phase.

Figure 7. A low-cost germination chamber made with black plastic bags

Water management

Once in the nursery, trays need to be irrigated. Irrigation is the single most important factor in producing high-quality seedlings, and will have significant impact on crop production. Good water management guarantees that seedlings will grow with health and uniformity, developing a good root system that enables nutrient absorption and ensures a high survival rate after transplanting.

There are many different ways to irrigate seedlings in trays, ranging from low-cost knapsack sprayers to more expensive, automated microsprinkler systems. The frequency and duration of irrigation will depend on the type of crop and substrate, as well as on climate. But in general, good irrigation requires that all cells receive the same amount of water from top to bottom, paying extra attention to those areas of the trays (typically at the edges) that receive more sunlight or wind.

Figure 8. Grafted tomato seedlings

Nutrient management

Nutrition must be carefully managed to ensure vigorous and healthy seedlings. As with water and irrigation, mismanagement of nutrition will result in elongated, weak and yellowish seedlings that will not be suitable for transplanting.

The type of substrate plays an important role in both water and nutrient absorption. For example, sterile substrates must be supplemented with all necessary nutrients to guarantee adequate nutrition. On the other hand, substrates with already incorporated nutrients will only require appropriate water management.

Locally made substrates (with soil, compost and other materials) will vary in their nutritional content, and good water and nutrient management is therefore needed to avoid imbalances.

Figure 9. Effect of water management on uniformity of seedling production

Pests and diseases

Correct management of pests and diseases during seedling growth is critical in preventing problems later on after transplanting, especially with fungi-related issues such as damping off and virus infections. Early identification of the pest or disease will help to increase efficiency in its control, thus minimizing the use and spread of pesticides and their associated costs. Basic recommendations to avoid disease include the following:

- Use sterilized substrates only.
- Use substrates with good drainage.
- Avoid sowing seeds too deeply.
- Keep trays separated to allow air to circulate.
- Use or graft with resistant varieties.
- Avoid excessive moisture from irrigation.
- Keep the nursery and surroundings clear of weeds.
- Cover the structure with plastic and anti-insect netting.
- Use sticky traps to monitor pests.
- Check the plants at least three times a day.

- Avoid visits from people who have recently been around or near open-field crops.
- When possible, use biological products for pest and disease control.

In general, an integrated pest management (IPM) approach is always recommended, with pesticides as an option of last resort for control.

Transport and transplant management

Everything should be prepared, ready and synchronized in advance, to avoid stressing the seedlings when transplanting. Seedlings can be transported to the field in trays or in clean baskets, as long as they are kept properly wet during the process and do not have direct contact with soil, pests or potential sources of infection from disease.

Before transplanting, trays should be well and deeply irrigated. This will help to remove the seedlings from the cells without damaging their root systems.

During the actual process, the larger and more vigorous plants should be selected and transplanted first, leaving the smaller plants to be transplanted at the end, as this will avoid competition in the field.

Figure 10. Transplanting seedlings from nursery to field

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