HS1186

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Solutions for Small Farmers and Home Gardens: Building a Low-Cost Vertical Soilless System for Production of Small Vegetable and Fruit Crops[1]

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INTRODUCTION

Soilless culture (commonly referred to as hydroponics) has been part of vegetable and small fruit production practices for decades in many countries throughout the world. These systems present obvious advantages for minimizing the incidence of soilborne disease, nematodes, and weeds in crops. The two basic components of these systems are the substrate—or growing medium—and the supporting structure.

Substrates can be either from organic or mineral materials. Perlite and vermiculite are among the most popular mineral media. Among the many organic substrates available are pine bark, burned rice hulls, coconut fiber, sphagnum peat, and mature compost. With proper management, these supply essential plant nutrients and improve water and air balance in the medium, in comparison to mineral substrates. The use of affordable and readily available substrates can increase the sustainability of those systems. The supporting structure includes the containers, irrigation, and fertilization equipment needed to operate the system.

Small farmers and homeowners have a long history of innovative production practices to reduce costs and improve yields of vegetable and small fruit crops. The incorporation of underused components—such as industrial byproducts, waste materials (e.g., soda bottles), and submarginal production areas—is encouraged in sustainable systems. This publication provides written and graphic instructions on how to build a homemade vertical soilless growing system (also known as "bottle grow") to produce vegetables and small fruit crops (Figure 1) at a fraction of the cost of commercially available systems, without occupying premium agricultural land and by utilizing materials available in the home and local hardware store.

MATERIALS AND TOOLS NEEDED TO BUILD A TOWER

The vertical soilless system (or "bottle grow") is based on strata (levels) of plastic bottles or pots filled with a soilless medium. Each level may have multiple pots (typically four), depending on the thickness and

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Figure 1. Finished towers of the homemade vertical soilless growing system ("bottle grow"). (Credit: B. M. Santos and T. P. Salame-Donoso)

shape of the supporting pole. For instance, a squared-section wooden pole holds one container on each side of the section for a total of four pots per level.

The suggested materials needed to build one tower are as follows:

- One 4 x 4 inch post or pole, preferably 8 ft tall
- For four levels, sixteen 2 L plastic bottles (e.g., soda bottles)
- A box of 3/4–1 inch wooden screws
- 10 ft of 3/4 inch or 1 inch diameter water hose or irrigation tubing
- 4 ft of plastic spaghetti tubing (1/4– 1/2 inch thick)
- Four irrigation emitters or "spitters"
- String
- Four 3 gal pots or similar
- Growing media (about 20 gal)
- Black or white spray paint
- Sixteen pieces (about 6 inches long) of a 1 inch diameter pipe
- Miscellaneous pipe fittings (e.g., elbows)
- Water timer (optional)

Tools required: A pair of scissors, a screwdriver, a single-hole puncher, and a shovel

ASSEMBLING THE VERTICAL SOILLESS SYSTEM

To assemble each tower:

1) Cut the bottom part of the soda bottles as indicated in Figure 2. Be careful to leave a 1 1/2 inch tab wide enough (about 3 inches) to punch a hole in the middle of it. This tab holds the bottle when hanging on the pole. Paint each bottle any color to reduce direct sunlight penetration.

Figure 2. "Lip" to support each hanging bottle. (Credit: B. M. Santos and T. P. Salame-Donoso)

2) Measure the underground 2 ft of each pole (Figure 3).

Figure 3. Measure the underground 2 ft of the pole. (Credit: B. M. Santos and T. P. Salame-Donoso)

3) Set the supporting pole (Figure 4).

Figure 4. Dig a 2 ft hole. (Credit: B. M. Santos and T. P. Salame-Donoso)

4) Set supporting pole in the ground; fill in and pack the removed soil (Figure 5).

Figure 5. Hole for the supporting structure. (Credit: B. M. Santos and T. P. Salame-Donoso)

5) Place one screw per side of the pole for each of the four levels (Figure 6).

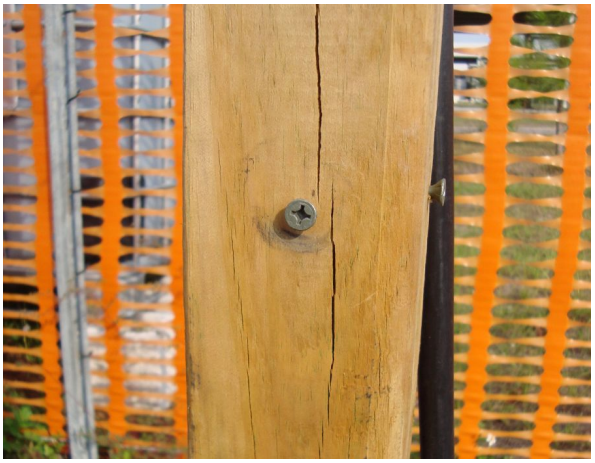

Figure 6. Screws on each side of the pole for hanging each bottle. (Credit: B. M. Santos and T. P. Salame-Donoso)

6) Install irrigation pipes and water timer (optional) on top and bottom of each pole (Figures 7–9).

Figure 7. Install irrigation pipes on top of each pole. (Credit: B. M. Santos and T. P. Salame-Donoso)

Figure 8. Set main pipe at the bottom of each pole. (Credit: B. M. Santos and T. P. Salame-Donoso)

7) Tie the necks of each bottle together within each level with a piece of string (Figure 10).

Figure 9. Install water timer (optional). (Credit: B. M. Santos and T. P. Salame-Donoso)

Figure 10. Tie the necks of each four-bottle set. (Credit: B. M. Santos and T. P. Salame-Donoso)

8) Place the growing medium (Figure 11).

9) Install the four pieces of spaghetti tubing on top of the pole and place one emitter on each for each side of the pole (Figure 12).

10) Install the 1 inch pieces of pipe on the necks of each bottle to ensure water drainage to the level below and place the 3 gal pots filled with growing medium on the ground (Figure 13).

11) Saturate the growing medium with water before planting.

Figure 11. Fill each bottle with medium. (Credit: B. M. Santos and T. P. Salame-Donoso)

Figure 12. Install spaghetti tubing on top of the pole. (Credit: B. M. Santos and T. P. Salame-Donoso)

Figure 13. Install 1 inch pieces of pipe on the bottom opening of each bottle. (Credit: B. M. Santos and T. P. Salame-Donoso)

CROP POSSIBILITIES AND RECOMMENDATIONS

This vertical soilless system relies on gravity to provide water from the top of each tower and allow enough drainage to the lower levels. At the same time, the upper levels of the tower tend to receive more direct sunlight than the lower ones. Therefore, crops with high tolerance to low-light conditions should be planted accordingly. The bottom 3 gal pots serve as a receptacle for excess water, fertilizers, and salt; thus, crops with moderate to high salinity tolerance should be considered for the ground level. If the grower or homeowner possesses a fertilizer injection system, fertigation is possible through the same plumbing. Otherwise, slow- or fast-release fertilizers should be used.

Possible crops for the two to three upper levels of each tower are strawberry, eggplant, determinate pepper, and leafy vegetables and herbs (e.g., lettuce, arugula, cilantro, basil). For the lower levels, onion, leek, collards, and other cole crops are suitable.