A NON-CIRCULATING HYDROPONIC KIT FOR LEAF AND SEMI-HEAD LETTUCE

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Abstract. A simple, non-circulating hydroponic kit consists of a 12 to 19 liter plastic container with a lid, growing medium, plastic forestry tubes and pre-weighed hydroponic fertilizer. The grower adds water and fertilizer to the container. The forestry tubes are filled with a growing medium and seeded with leaf or semi-head lettuce cultivars. The tubes are suspended by the cover of the container such that the lower 3 cm are immersed in the nutrient solution. Thus, plants are automatically watered by capillary action. Roots continue to absorb adequate water and nutrients after the nutrient solution level has dropped below the bottom of the tubes. No additional maintenance is needed until harvesting. No aeration or circulation is required.

KEYWORDS: Non-circulating hydroponics, lettuce, containers, capillary moisture movement

INTRODUCTION

Non-circulating hydroponic methods do not require mechanical aeration or circulation of nutrient solution. Therefore, pumps and electrical power are not required for these systems.

Kratky (5) discussed sub-irrigating pots of lettuce with nutrient solution. The pots were supported by the tank floor. Screen or net bags filled with a planting medium (1), rockwool cubes (3), plastic pots with a screen bottom (4) and plastic forestry tubes (6) were suspended from the topcovers of tanks containing nutrient solution. Munsell (2) designed special plant holding tubes wherein nutrient solution rose by capillary action through their porous walls.

Educators, hobby gardeners, condominium dwellers and plant researchers have a need for a low maintenance hydroponic system capable of sustaining several plants. The objective of this study was to develop a non-circulating hydroponic kit based upon the plastic forestry tube concept (6) which would not require any attention from the time of planting until harvesting.

MATERIALS AND METHODS

The kit consists of a 19 liter plastic bucket with a lid, growing medium, 4 plastic forestry tubes (Ray Leach Cone-tainer Super Cells) and a packet of fertilizer. The growing medium should allow upward capillary moisture movement and also be porous. Many artificial potting media such as a 5 fine peat:3 vermiculite:2 perlite mixture are acceptable. An additional ten 4-mm-diameter holes should be drilled in the tapered, plastic forestry tubes (40 mm diameter x 218 mm deep) to provide for supplemental aeration of roots in the tubes. The 12 gram fertilizer packet consists of 10N-3.5P-18K plus 5Ca-1Mg-2S-0.02B-0.01Cu-0.2Fe-0.1Mn-0.005Mo-0.01Zn.

Water is added to a level 10 cm from the top of the bucket (Figure 1). One packet of fertilizer (12 grams) is added to the water and the lid is placed over the bucket. The forestry tubes are filled with moistened growing medium and tapped lightly on a solid surface in an effort to pack the medium and prevent air voids which would hinder capillary action. The tubes are suspended from the bucket lid such that the lower 3 to 6 cm are immersed in nutrient solution. Seeds of 'Salina' semi-head lettuce or 'Green Ice' leaf lettuce or similar cultivars are planted at a 6 mm depth. Seedlings may also be transplanted into the tubes. The growing kit must be protected from rainfall by placing it in a greenhouse or under the roof overhang of a building.

Under normal circumstances, no additional water or fertilizer needs to be added. However, when the nutrient level becomes low, water should be added only in increments of 1 liter at a time. Adding too much water may cause the roots (which become acclimated to a microclimate of moist air) to drown. Plants should not be disturbed during the later stages of crop growth because roots may suffer damage, thus impairing future plant growth. After harvesting the crop, the remaining nutrient solution may be applied to the lawn or some other garden or yard plants. Then, proceed to rinse the buckets with water, empty the medium from the tubes and repeat the growing cycle.

RESULTS AND DISCUSSION

In larger scale greenhouse trials with containers holding 15 to 200 plants, fresh weight yields ranged between 80 and 250 grams per head with over 20 lettuce cultivars. 'Green Ice' averaged 167 grams per head in 10 experiments with a mean growing period of 52 days. 'Salina' averaged 164 grams per head with a mean growing period of 51 days.

Nutrient solution uptake normally ranged between 2 and 4 liters per plant for the 6 to 7 week growing period. The ratio of liters water consumption:kg fresh weight production usually ranges between 15 and 25 in Hawaii's climate. Thus, a 150 gram plant normally requires 2.25 to 3.75 liters of water. This is a very efficient use of water. It was necessary to add water to the 12 liter containers since they only contained about 6 liters of nutrient solution at seeding time. However, the larger containers seldom required additional water.

No additional fertilizer was added whenever supplementary water was added. The fertilizer application rate was based upon a projected fresh weight of 200 grams per head although the actual fresh weight is usually less than this. Initial electrical conductivities of the nutrient solution ranged from 1.0 mS for 15 liters of nutrient solution in the 19 liter bucket to 2.5 mS for 6 liters of nutrient solution in the 12 liter storage container. Acceptable growth occurred in both circumstances.

Other short-term crops suitable to grow with the hydroponic kit include kai-choy and several types of herbs. Longer-term crops such as cucumbers and tomatoes have also been successful, but they quickly absorb all of the nutrient solution and require frequent additions of both water and fertilizer. This would pose a difficult problem for many gardeners.

Alternative containers to the 19 liter plastic bucket include a 19 liter expanded polystyrene ice chest lined with a trash bag to prevent leakage, a 12 liter plastic storage container and 12 and 19 liter plastic pots.

Gardeners who have no soil, poor soil or disease-infested soil will now be able to grow plants with hydroponic kits on porches, verandas and under overhangs of buildings.

Educators need a low maintenance and inexpensive method of teaching students about plants. A hydroponic kit can be prepared and planted in one class period and no additional maintenance will be needed. Students will be able to observe a lettuce seed germinate and grow to an edible product in about 6 to 7 weeks. The low cost of the kit ($10-$20) should enable widespread use as a teaching tool.

Researchers may find this concept useful to conduct nutritional studies, to test pesticides and to produce seed.

A patent application has been filed for the hydroponic kit.

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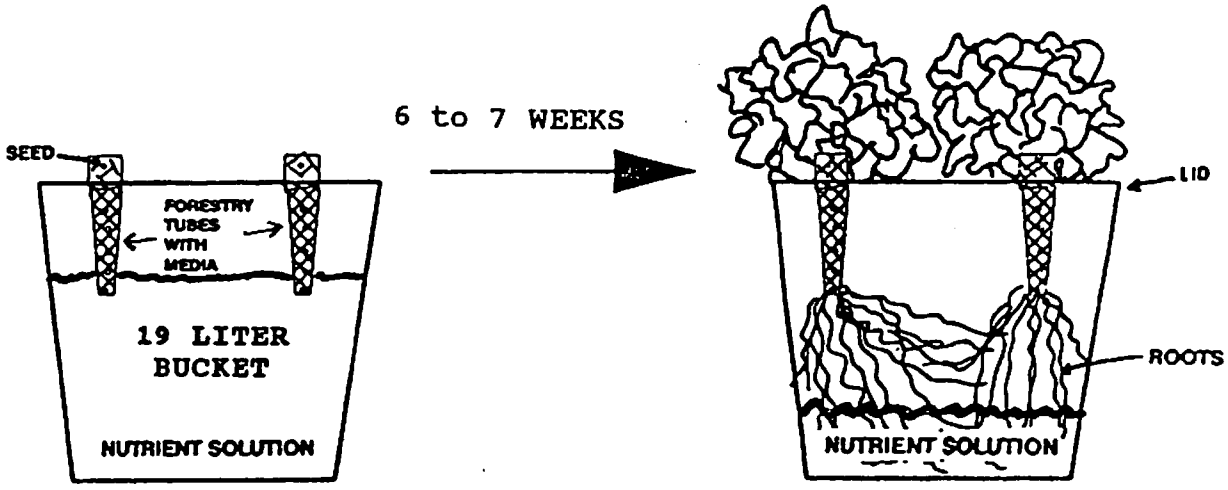

Figure 1. Lettuce growth with a non-circulating hydroponic kit.