

## Controlled Environment Agriculture for Homeowners

Brylin Nelson and Kent Kobayashi

University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources

### INTRODUCTION

Controlled Environment Agriculture (CEA) is a form of agriculture that creates optimal growing conditions through the manipulation and control of the environment. The main goal of CEA techniques is to protect crops from outdoor elements and create optimal conditions for plant growth and development. This is done using carefully chosen practices and equipment such as greenhouses, shadehouses, and artificial lighting. The extent of manipulation the environment undergoes can vary greatly depending on the desired outcome, purpose, space, and money.

CEA is commonly seen in the form of vertical or urban farming as well as indoor agriculture. CEA production covers a wide variety of crops from herbs to fruits and vegetables. In large scale operations different tools are utilized to create an environment most favorable to specific plants or to promote specific types of growth, flowering, and fruit formation. Examples of CEA can be seen in the form of greenhouses and indoor crop production facilities such as MetroGrow Hawaii and Oasis Biotech in Las Vegas, NV (Figure 1).



Figure 1. Oasis Biotech, Las Vegas, NV, is one of the largest indoor hydroponic vertical farming facilities in the U.S.

## FOOD SECURITY IN HAWAII

The state of Hawaii's ever-growing population and decreasing amount of agricultural land means that our ability to produce sufficient food is becoming more difficult.

Currently, the state imports 85-90% of all food products. If an event were to occur in which ships and planes were unable to come to the islands, we could run out of food in about seven days. This is a major issue that individuals can help better on their own by growing produce at home. The use of CEA techniques would help enable everyone, no matter the amount of space or time, to create a protected cultivation home garden.

## BENEFITS

The benefits of CEA include reduction of bugs resulting in less pest control, minimal weeds and plant diseases, little to no mess (depending on growing medium used), and increasing water use efficiency. CEA is a great alternative for those who live in highly

populated areas and who may not have an outdoor yard or garden. CEA can also save money on groceries.

## HOW TO SET UP

CEA setups vary in their complexity and cost for the homeowner. As such, they could be purchased from most hardware stores or online storefronts such as Amazon. Some CEA setups are relatively simple and less costly, enabling the homeowner to build their own system. They do not require large amounts of outdoor space such as for a typical garden. They can be placed on a covered lanai area as well as inside a home in a structure such as a grow tent (Figure 2). The basic setup includes some type of shelving to support the plants and light-emitting diode (LED) grow lights or high intensity fluorescent lights to provide artificial lighting (Figure 2).



Figure 2. LED lights (top) and high intensity fluorescent lights (bottom) providing artificial lighting for hydroponically grown tomatoes in a grow tent.

For the growing medium, a commercial or homemade potting soil mixture can be used. Or, for a soilless option, there are many media available such as clay pellets, wood

chips, volcanic cinder, gravel, or stones. A compressed foam medium such as Oasis cubes or rockwool cubes are convenient to use and offer the advantage of being sterile (Figure 3).

Reused drink cartons can be used to hold a hydroponic nutrient solution for the plants (Figure 4). The nutrient solution mix can be purchased from various horticultural companies and Amazon as well. Another option is to place Oasis cubes or potted plants in a tray and pour the nutrient solution into the trays (Figure 5). With these techniques daily watering is not necessary, and the plants are able to take up as much water as needed.



Figure 3. Plastic net pots are used to hold Oasis cubes, rockwool cubes, or a potting mix to grow plants in a hydroponic nutrient solution.



Figure 4. Micro-hydroponics, the use of drink cartons containing a hydroponic nutrient solution to grow plants in net pots.



Figure 5. Green onions growing in Oasis cubes in a plastic tray containing a hydroponic nutrient solution.

Easy crops to grow include leafy greens and herbs such as basil, thyme, and rosemary which offer the advantages of a smaller size and being able to pick off the desired plant parts as the plants continue to grow and reproduce. Other crops include dwarf vegetable varieties such as lettuce, dwarf curled kale, tomato (Figure 4), and chili pepper (Figure 6). Plants that are already of short stature are great options as well, such as Mānoa lettuce and Koba green onions (Figure 5). You can buy seeds or plant starts at local nurseries.



Figure 6. Chili peppers grown in a net pot in a hydroponic set up under artificial lights.

## CONCLUSIONS

CEA farming techniques such as urban farming have become more popular recently and will continue to grow in popularity as populations increase and more areas urbanize. It is a source of safe, locally grown produce and can be done relatively easily and is more affordable than most would think. It takes little to no experience or effort to set up your own indoor CEA garden and has so many benefits to an outdoor garden with minimal to little pests, plant diseases, and weeds. With Hawaii's food importation issue, home CEA systems can become more widely used in residential homes across the state.