

Vertical cropping and hydroponics

Technical gardener Mike Philips and assistant volunteer David Webster explain the vertical cropping system at Paignton Zoo Environmental Park in Devon. They describe the way in which high tech innovation is combined with efficient use of resources, making it a sustainable production system.



The zoo collaborated with the Cornish company Valcent (EU) Ltd. to build Europe's first high-density vertical growing system (Verticrop™). There is the capacity to grow 11,200 plants in an area covering approximately 85 meters squared, more than three times what would be expected of a conventional hydroponic system.

Multi-level growing trays are suspended from upright hangers on an overhead conveyor. The system uses reduced quantities of space, light, water and heat. Crops are grown using hydroponics; the soil-less nutrient solutions contain all the necessary mineral elements.

Food is produced very quickly and is used to feed animals on site, which benefit from the improved nutritional

value. The crops are also being used in the zoo restaurant.

"All plants are grown from seed on site" says Mike, "to prevent diseases coming in and to save money."

They are then placed sequentially in to the growing trays. The leafy salads, vegetables and micro greens are suspended from an overhead rack that carries 70 hangers. Each hanger holds 16 trays in a system comprised of 8 levels stacked 3 meters high.



"The trays are moved around the greenhouse track to ensure even air and light distribution (stopping at night time), and to allow for centralised locations for irrigation and the unloading and loading of crops" explains Mike. "Each circuit takes about 40 minutes. The system lifts the trays up and down so that the plants can be harvested. After the first cut, and as soon as plants are well established, they are usually swapped round."

Water and nutrients are supplied from a central feeding system. Mike demonstrates how to operate the computerised environmental control system which directs the growing environment and integrates the hydroponic technology.



“The nutrient content can be varied according to the selected crop. You can also input instructions of where you want the conveyor to stop to help with watering.”



Water is recycled and run-off solutions are captured, filtered and recycled through the whole irrigation system. This enables a saving on water and nutrient use and avoids the pollution often associated with field grown crops.

The system is housed within a low energy polythene structure that is double skinned with a polythene film on the roof to retain heat, reduce

scorch, and provide optimal light levels. Mike explains that *“the system is currently run by an electric meter but could potentially be run by solar power.”*

Fans are used to control temperature and humidity. Under floor heating is used to maintain a frost-free growing environment, and rainwater is harvested from the roof. The energy efficient measures and on-site growing of food crops means that there is great potential to reduce the carbon footprint.

Figures suggest a water use efficiency of one sixth of that of conventional agriculture and 20 times the crop per unit of land. When compared to other advanced hydroponic systems based upon a single layer, the system uses one third of the energy use per unit of yield (kWh per kg). Current projections for the system are over 50 per cent gross margin from a £250,000 crop yield of micro-greens, if sold at whole sale value of 5 – 9 pence per gram from a full sized commercial unit of 212 meters squared of production.

Kevin Frediani, curator of Plants and Gardens at the zoo, and driver of the project, believes it is an example of resource efficiency through the recycling of water, monitoring of nutrients, and maximisation on the amount of space available. Benefits include being able to grow a large diversity of crop plants, provision of plants all year round, without having to account for weather changes and impacts on field grown crops, a reduction in food miles and food costs, and an increase in the food security of the organisation.