Building a SEED Park: Part VII – Hydroponic Production

In the arid parts of the world, it seems strange to speak of cultivating plants in water or hydroponics. This culture technique can, however, be much more conservative of water than are traditional croplands. In "Water", Part V of this series of articles, figures were provided for the water requirements of various agricultural crops and products. These figures were from Mr. Peter Doyle and based on data from New Zealand. Let's now consider the San Luis Valley.

Merlon A. Dillon, Area Extension Agent – Agronomy, provided data obtained from the Colorado Agricultural Statistics for 2006 for the major crops of the San Luis Valley. These data included crop yield (bushels or tons/acre) and production value per acre. Mr. Dillon also provided data on water requirements for these same crops. These three sets of figures were then used to calculate the gallons of water required to produce $100 worth of spring wheat, spring barley, alfalfa hay, fall potatoes, spinach, lettuce, and carrots.

San Luis Valley Crops		
	Water/A (gal)	Gal/$100
Alfalfa Hay '05	749,406	187,821
Spring Wheat '05	553,908	180,426
Spring Barley '05	456,160	100,920
Spinach '03	325,829	12,398
Fall Potatoes '05	390,994	11,409
Lettuce '05	325,829	7,670
Carrots '04	325,829	4,973

*Merlon Dillon, Extension Agent

The most water-efficient crops growing in the San Luis Valley are carrots, lettuce and potatoes. Even as efficient as these crops are, they are still inefficient as compared to hydroponic production, which uses only 158 gallons of water to yield $100 worth of produce.

Water for AG Products*	
Product	**Gallons of water/$100 output**
Rice in the husk	196,263
Seed Cotton	42,105
Dairy & whole milk	38,684
Sugar cane	32,368
Beef cattle	21,368
Vegetables & fruit	9,974
Wheat & grains	6,710
Hydroponic vegetables	158

*Peter Doyle, New Zealand. 2006.

What's required for hydroponic production? One doesn't need big tractors and big fields, but one could use large greenhouses and barriers or containers to control the flow and dispersion of water. Some hydroponic plants are produced with their roots submerged in water, whereas others are grown using the nutrient film technique (NFT). With NFT systems the roots are kept moist, but not flooded in water. For demonstration, Disneyworld's pavilion "The Land" has plants suspended from overhead containers on a moving track that passes through a spray of nutrient-rich water. The roots are in the air.

In commercial-level NFT systems, plants are commonly maintained in plastic containers or troughs and the roots are kept moist by cyclical flooding. Many plants that would not survive with their roots flooded do very well when briefly flooded and then exposed to air as the water drains away.

In an arid environment, getting rid of nutrient-rich water discharged from feedlots, dairies, meat processing plants, or from municipal wastewater treatment plants is sometimes as difficult as finding fresh water. Nutrient-rich discharges typically contain various levels of nitrogen and phosphorous. These nutrients that threaten quality of ground and surface water are the same nutrients farmers buy and apply to croplands as fertilizers.

Nutrient-rich effluents can be used in hydroponic culture to produce plants destined for the ornamental, energy, or fiber markets. Hydroponic plants will remove the nutrients, cleaning the water in the process, producing both and additional crop and the opportunity to further recycle the water. Water never wears out; it just gets dirty. Hydroponics is a method of maximizing production from limited resources.

What are some of the plants one could produce hydroponically? High-value plants are those that people want – not those that they must have. For example, organic produce is typically priced higher than is non-organically grown produce.

One fish producer in Oklahoma used nutrient-rich effluent from a tilapia tank to grow chives hydroponically. His chives were marketed by contract at over $5/lb throughout the year. Chives available from typical farm production were very seasonal and the price plummeted to about $0.10/lb when harvest was at its peak. Furthermore, the chives produced hydroponically were crisp and had a shelf life of about 2 weeks, as compared to the 2 to 3-day shelf life for field grown chives.

Lettuce, spinach, water cress, and even melons have been grown hydroponically. Some ornamental plants are produced hydroponically in to provide larger, more vigorous plants for springtime planting. Texas Tech University, has recently reported annual production of 58 tons (dry weight)/acre for water hyacinth grown in a greenhouse in water with levels of nutrients similar to that in discharges from wastewater treatment plants. This quantity of water hyacinth could yield 158 kWh if converted into methane by anaerobic digestion. Hydroponic systems producing energy plants, or algae containing oils, for biodiesel production yield not only a high-value crop, but also a cleaner effluent.

South of the San Luis Valley and just north of Taos, NM there is a group of homes known as earthships. These structures are built with south-facing windows and earth-bermed north walls. Many of these homes are energy and water self-sufficient. They generate their own power, via solar and wind, and capture all precipitation from the roofs. Water is cycled and recycled through hydroponic plants and sub-surface flowconstructed wetlands. The individuals in the earthships are proving today that hydroponic culture is economically viable.

Many fish production facilities, such as Colorado Gators in the San Luis Valley, employ hydroponic plants to extract nutrients. Removing nutrients from the water allows the water to be recycled for multiple times, increasing production of both fish and plants.