

GREENHOUSE AND HYDROPONICS SYSTEMS

Richard G. Snyder

Mississippi State University, USA

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Summary

A review of the background and history of hydroponic (soilless) greenhouse production systems is provided, followed by details of producing greenhouse tomatoes, the most prevalent crop. U.S. greenhouse vegetable demographics are covered, as well as variety selection, essential tools, pollination, tips for new growers, and links to Web sites for more comprehensive information.

1. Introduction

The business of raising greenhouse, or hydroponically grown, plants such as tomatoes, while not new, has become a very popular pursuit for small landowners, those who wish to diversify their farms, or people who are looking for supplemental income. A new grower can get into the business with a single bay 24 ft by 96 ft (7.32 m x 29.28 m) greenhouse for about US\$20 000 in loan capital. A greenhouse this size can gross in the neighborhood of US\$10 000 per year, making the payback period very attractive.

However, anyone interested in this business should be very clear about the time commitment and amount of work involved before breaking ground for new greenhouse construction. In fact, raising greenhouse tomatoes is more similar to a dairy farm or a

chicken farm in that growers need to be present to perform some tasks every day. Leaving the plants alone for a day or two without someone to tend to their needs could easily lead to a disaster and crop loss.

2. History

As mentioned, hydroponics is not a new concept. In fact, the Hanging Gardens of Babylon, in which plants grew in a stream of water, and the floating gardens in Mexico grown by the ancient Aztecs can be considered to be the first or at least some of the earliest recorded events of employing hydroponic techniques.

The hydroponic method was researched in the 1860s by the German scientists Sachs and Knop, who did work with plant nutrition. But it was Dr. W.F. Gericke, a California professor, who in the 1920s and 1930s furthered the development of hydroponics and popularized the terminology. In the 1930s and 1940s additional hydroponics research was performed in the United States, Japan, and Europe. Today hydroponics is used worldwide for vegetable, fruit, and flower production. There are an estimated 60 000 acres of greenhouse vegetables grown hydroponically in the world today.

Plants do not require soil to grow. While soil does provide anchoring for the plant, and absorbs and releases both nutrients and water, there are other media that can serve this purpose. The use of hydroponics eliminates some of the problems inherent in soil-based production systems. Along with soil come some rather serious soil-borne diseases that can be avoided in hydroponic systems. Non-soil media give better control over the root environment, including moisture level, aeration, temperature, and fertility, in addition to avoiding some insect, disease, and weed problems. Also, in locations where high quality soil is not available due to poor drainage, low fertility, noxious weeds, etc., alternative media can be used.

Furthermore, by growing crops in a greenhouse (whether hydroponic or not), much better control over other environmental variables can be achieved. The greenhouse structure can be thought of as a shell that protects the crop inside from the harsh and unpredictable environment outside. It allows regulation of air temperature, light, humidity, irrigation, carbon dioxide, and even restricts entry of some insect pests.

By improving control over all of these variables, productivity in hydroponic greenhouse crops is much higher, quality is better, and the risks associated with production are lower than with comparable field-grown crops. Therefore the profit potential is greatly enhanced.

3. Definitions

The word hydroponics comes from two Greek words, *hydro*, which means water, and *ponos*, which means labor. So, hydroponics is the concept of “working water,” or putting the water to work. Hydroponics today has a wide array of definitions, from the very broad to the extremely narrow. The latter define hydroponics as growing plants in water solutions, such as the “pure” hydroponic methods of nutrient film technique (NFT), ebb and flood, and PVC pipe systems, as well as aeroponics and mist culture systems. The broad definition would include all of these, as well as all other systems except growing plants in

the soil. Currently, the broader definition is in favor in most areas, so we might think of hydroponics as synonymous with “soilless culture.”

Other systems that are hydroponic by the broader definition, besides those already mentioned, include growing plants on rockwool or glasswool slabs or aggregate, or in containers filled with peat moss, peat-lite (peat and vermiculite mixtures), perlite, pine bark, sawdust, or any of a variety of other media. Rockwool is a spongy material made of molten rock. Due to its physical properties, it is a good medium for root growth.

In the United States, most of the larger greenhouse ranges (i.e. those over 20 acres), use rockwool or glasswool slabs as the growing medium of choice. This is due to the convenience of handling the slabs, including installation in the greenhouse, transplanting, and removal. Some smaller growers use rockwool, as well as a variety of other media, especially perlite, peat-lite, and pine bark. Others grow tomatoes in the soil (non-hydroponic), which can also be acceptable, especially for organic operations.

All of the various systems mentioned can work for plant production. However, the selection of the system and medium should be based on economic considerations as well as practicality.

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Visit: <http://www.eolss.net/Eolss-sampleAllChapter.aspx>

Bibliography

The Greenhouse Tomato FAQ: <http://www.msucare.com/crops/comhort/greenhouse.html> [information in a user-friendly question and answer format. It also includes entire Extension publications on line, and has links to many of the hydroponic, greenhouse vegetable, and pest management Web sites.]

Biographical Sketch

Dr. Richard G. Snyder is Extension Vegetable Specialist and Research Horticulturist, Mississippi State University. He is responsible for research in field and greenhouse vegetable crops, especially cultural practices, specialty crops, plastic and degradable mulches, trickle irrigation, cultivar trials, etc. He publishes *Vegetable Press*, a monthly newsletter for county agents and commercial vegetable growers.