Hydroponic vegetable production

Guide

agriculture,
forestry & fisheries

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Hydroponic vegetable production

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What is hydroponics?

Hydroponics is a technology for growing plants in nutrient solutions (water containing fertilizers) with or without the use of an artificial medium (sand, gravel, vermiculite, rockwool, perlite, peatmoss. coir, or sawdust) to provide mechanical support.

As seen in the picture, irrigation pipes carrying nutrient solutions (water containing fertilizers). Also notice the plastic containers containing artificial medium to provide mechanical support

Liquid hydroponic systems have no other supporting medium for the plant roots*: aggregate* systems have a solid medium of support. Hydroponic systems are further categorized as *open* (i.e. once the nutrient solution is delivered to the plant roots, it is not reused) or *closed* (i.e. surplus solution is recovered, replenished, and recycled).

Hydroponic growing (as opposed to soil growing) allows you to control the nutrient levels for your plants directly. Because of the higher control over nutrients, hydroponically grown plants generally have a much higher yield than similar plants grown in soil.

Hydroponics growing

A plant gets its food source by turning Co_2, light and water (or hydrogen) into carbohydrates through a process called photosynthesis. With hydroponics growing, plants are grown without soil so they must get their nutrients from the nutrient solutions added to water. The absence of soil in growing means that hydroponics systems must have some way of supporting the plants while still allowing the bare root system maximum exposure to the nutrient solution.

Often a “growing medium” is used for support and to aid in moisture and nutrient retention in hydroponics growing.

Because they lack media to store water and nutrients, water culture systems need a continuous flow of nutrients to prevent drying out the plant roots.

Plants need an energy source in order to grow. With hydroponics growing this energy may come from natural light, which has the full spectrum of color or through the use of different types of artificial lighting (grow lights), which can be selected for specific plant varieties and optimum plant growth characteristics.

What do you need to start hydroponic production?

Garden production unit	Commercial production unit
• Source of clean water • The right location • Specially formulated fertilizer • Time to attend to the system daily • A little knowledge of plants or gardening • A commercial or home made unit	• Water is the most important considera-tion, that is in terms of quality, quantity and reliability. • Market. Know what, where and when to market your crop. • Hydroponics is labour intensive. During peak season, labour must be available for 7 days a week. • Management skills: Production, labour, marketing and infra-structure. • Expertise in crop production, fertilisation and irrigation, pests and disease man-agement. • Location: Infra-structure, labour, market, etc. • Financing: The amount needed depends on the size, type of greenhouse, labour cost and your market. • Dedication: labour and management in general.

Garden production unit (above picture) vs commercial production unit (below)

With garden production unit, source of energy derived from natural light whereas with commercial production unit, source of energy derived from artificial lighting (grow lights).

Basics of hydroponics

To be able to produce vegetables successfully year after year, one needs to be familiar with the basics of hydroponics in term of the plant, growing medium, water and nutrients.

Which crops can be grown in hydroponics?

Basically all high value crops can be grown. Popular in South Africa are tomatoes, cucumbers and peppers in drain to waste systems and lettuce and herbs in gravel flow systems.

Where cay you buy seeds?

Seeds are available in small or large packages. Small packets are sold at nurseries, co-ops and retail stores and are suitable for garden – and small-scale hydroponic units. Large packets, suitable for commercial scale production are available from seed companies.

Taking care of plants

Different crops are planted at different spacing. Small-growing plants can be planted close to each other. Large-growing plants need more space to grow and must be spaced further apart.

- Water flow must be checked every day and adjusted when necessary.
- If plants turn yellow, it is normally a symptom of nutrient deficiency, too little light or a disease.
- Inspect the leaves every day for disease symptoms and insects. Act immediately if a problem occurs.
- Tall plants need to be trained and pruned to make optimal use of the expensive greenhouse space.

Differences between hydroponic vegetable production and soil production

Hydroponic	Field production
• No soil is required.	• Good topsoil is required. • Good soil = good drainage, compost, disease-free.
• Plants are irrigated automatically. • No water stress.	• Plants need to be irrigated to minimise water stress
• Plants are irrigated automatically. • No water stress.	• Plants need to be irrigated to minimise water stress
• Nutrients are available at all times • Only soluble fertilizers are used. • Hydroponic fertilizer formulations contain a balanced nutrient content	• Nutrients must be added to soil. • Unless a laboratory analysis is done, too much or too little nutrients can be added.
• Soil borne diseases can be eliminated	• Soil borne diseases can build up in the soil.
• Hydroponic production is not organic because artificial nutrients are always used and plants are usually not grown in soil.	• It is possible to produce organic vegetables in soil because one can use organic fertilizers such as compost and manure.

Hydroponics systems

Using hydroponics systems, mineral nutrients are dissolved in water and feed directly to a plant's root system allowing the plants to focus their energy into growing mostly upward, promoting quicker growth, faster harvests and higher yields. Hydroponics systems are used year-round both indoors and outdoors for growing herbs, foliage and food items. Hydroponics setup do not use soil but instead, use an inert growing medium to anchor a plant's roots.

The different types of hydroponics systems available include nutrient film, drip watering, aeroponics, Ebb and flow and passive systems.

Nutrient film

Hydroponics gardening utilizing an oxygen rich nutrient solution, is an ideal system for a wide range of crops including lettuce, strawberries, herbs, flowers, tomatoes, peppers, eggplant, squash and cucumbers.

Drip watering

Popular with small commercial hydroponics growing operations, hobbyists and schools this system is designed to grow tomatoes, cucumbers, peppers, herbs and flower crops.

Aeroponics

Excellent for starting large crops of seedlings, transplants and cuttings or growing plants or crops to full maturity, this system sprays the roots with nutrient-rich water.

Ebb and flow

Popular for rooting cuttings, germinating seedlings and vegetating young plants which are fed automatically with a simple flood and drain watering method.

Passive systems

Great for home or office this system can grow any type of vegetative, flowering or fruiting plant. The plant determines when it needs water and nutrients.

Relatively simple to operate and very easy to maintain, hydroponics systems provide the right conditions allowing plants to grow between two and four times faster than those in soil.

Advantages of hydroponics

- No soil is needed
- The water stays in the system and can be reused- thus, lower water costs
- It is possible to control the nutrition levels in their entirety- thus, lower nutrition costs
- No nutrition pollution is released into the environment because of the controlled system
- Stable and high yields
- Pests and diseases are easier to get rid of than in soil because of the container's mobility

Disadvantages of hydroponics

- The hydroponic conditions (presence of fertilizer and high humidity) create an environment that stimulates salmonella growth.
- Another disadvantage is pathogens attacks including damp-off due to Verticillium wilt caused by the high moisture levels associated with hydroponics and overwatering of soil based plants.
- Also, many hydroponic plants require different fertilizers and containment system.

Harvesting

In general vegetable crops are perishable and their shelf life and quality depend on number of actions. Such actions include:

- Pick at the right stage without damage to the plant.
- Pick early in the morning or when it is cool.
- Keep picked vegetables out of the sun.
- Handle carefully.
- Store them at the right temperature (depends on crop).
- Use the right packaging (depends on crop and market).
- Transport with care.

Pests and diseases

The optimal growing conditions for plant growth also provide favourable conditions for the development and spread of diseases and pests. Hydroponic producers are thus faced with the challenge of maintaining conditions optimal for plant growth but not for disease or pest development. This balance is often very difficult to maintain, and systems must be managed carefully.

It is important for a producer to know what pests or diseases are likely to become a problem. Steps can then be taken to reduce the possibility of the pest or disease entering the greenhouse and gaining a foothold on the plants.

Tips to prevent spread of diseases

- The most important tools are knowledge and dedication
- Several cultivation practices can prevent the spread of disease (e.g. crop rotation)
- Sanitation, i.e. cleanliness inside and outside the greenhouse or planted area as well as all persons entering the planted area.

Use of pesticides

Where to get/buy suitable pesticides?

Small scale/house hold hydroponic producers can buy pesticides in small packages available at nurseries, co-ops and certain retail stores.

Commercial producers can obtain bigger quantities from agrochemical companies.

Pesticides can always be effective only if:

- The pest has been identified correctly. (This can be tricky!)
- The pesticide is applied correctly. This includes mixing, spray technique, time of day, etc. users are advised to contact an expert such as the Roodeplaat Diagnostic Centre (tel: 012 841 9611) if you are uncertain about the identification of the disease or pest. Only registered pesticides may be recommended.

Legal aspects

In South Africa all chemicals used for the control of any pest or disease on a plant must be registered for such use under Act 36 of 1947 (Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act). An amendment to this Act (No. R.1716 of 26 July 1991) prohibits the acquisition, disposal, sale or use of an agricultural remedy for a purpose or in a manner other than that specified on the label on the container.

All registered chemicals in South Africa are published in a two-volume guide ,viz. “A Guide for the Control of Plant Diseases” and “ A Guide for the Control of Plant Pests “ issued by the Department of Agriculture, Forestry and Fisheries on a regular basis.

Availability: Resource Centre
Private Bag X144,
Pretoria 0001
Tel: +27 (0) 12 319-7141.

Acknowledgements

http://www.hydroponics-growing-systems.com/hydroponics-growing.html

http://en.wikipedia.org/wiki/Hydroponics#Advantages

http://www.hydroponics.com/

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