# Introduction to Hydroponics

## Lesson Aim

Discuss the nature and scope of hydroponics systems.

### INTRODUCTION TO HYDROPONICS

Hydroponics is the process used to grow plants without soil and literally means ‘working water’. The grower is taking ‘control’ of the plant's root environment, and losing the benefit of ‘mother nature's’ finely-tuned mechanisms which normally control that part of the plant's environment.

Hydroponics is not an easier way to grow plants! It is a more controlled way of growing plants!

Growing in hydroponics can offer the following advantages:

- It can reduce the physical work involved in growing.
- It can reduce the amount of water used in growing.
- It can save on space...more can be grown in the same area.

There are six basic types of hydroponic systems:

- Wick
- Water Culture
- Ebb and Flow (or flood and drain system)
- Drip (with either a recovery or non-recovery process)
- N.F.T. (Nutrient  Film Technique)
- Aeroponic

Over time the basic models have evolved and resulted in hundreds of different variations.

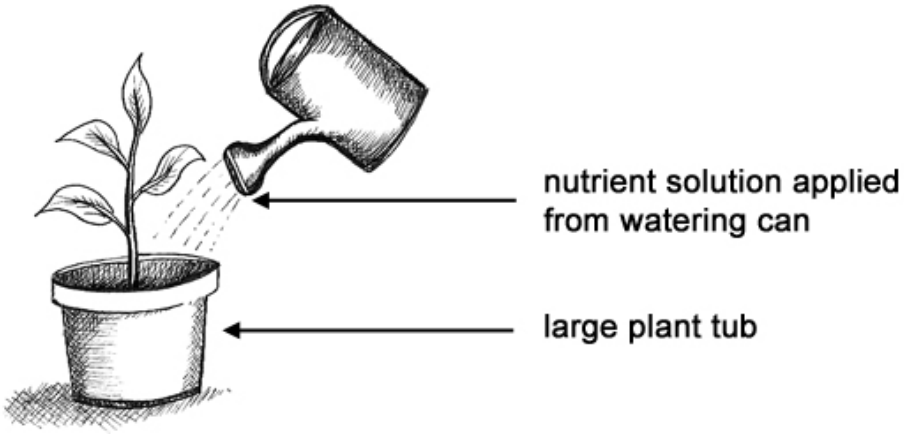
## Wick System

The wick system is passive, with no moving parts, and is also the simplest type of hydroponic system. The nutrient solution is drawn into the growing medium from the reservoir with a wick. The grower using this system can use a variety of growing media such as perlite, vermiculite or coconut fibre. However large plants tend to draw and use the nutrient water at a faster rate than the wick can supply it.

## Water Culture System

The water culture system is the simplest active system to use. A styrofoam platform floating on the nutrient solution holds the plants. Oxygen is supplied to the roots of the plants through a bubbling air stone that is attached to an air pump. Water culture is the system most often used for leafy vegetables such as lettuce that require fast growth and ample water. It is not suitable for most other plants that require a longer growing period.

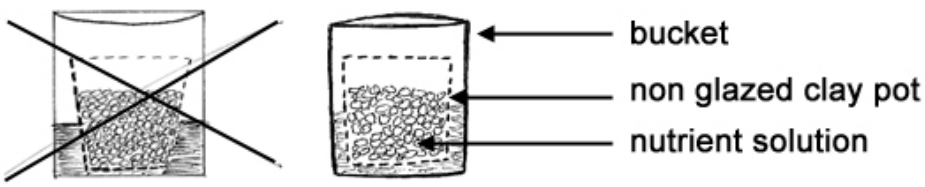
The Pot plant is the simplest system involving a pot filled with an inert hydroponic media (eg sand or perlite)




Capillary Fed Pot

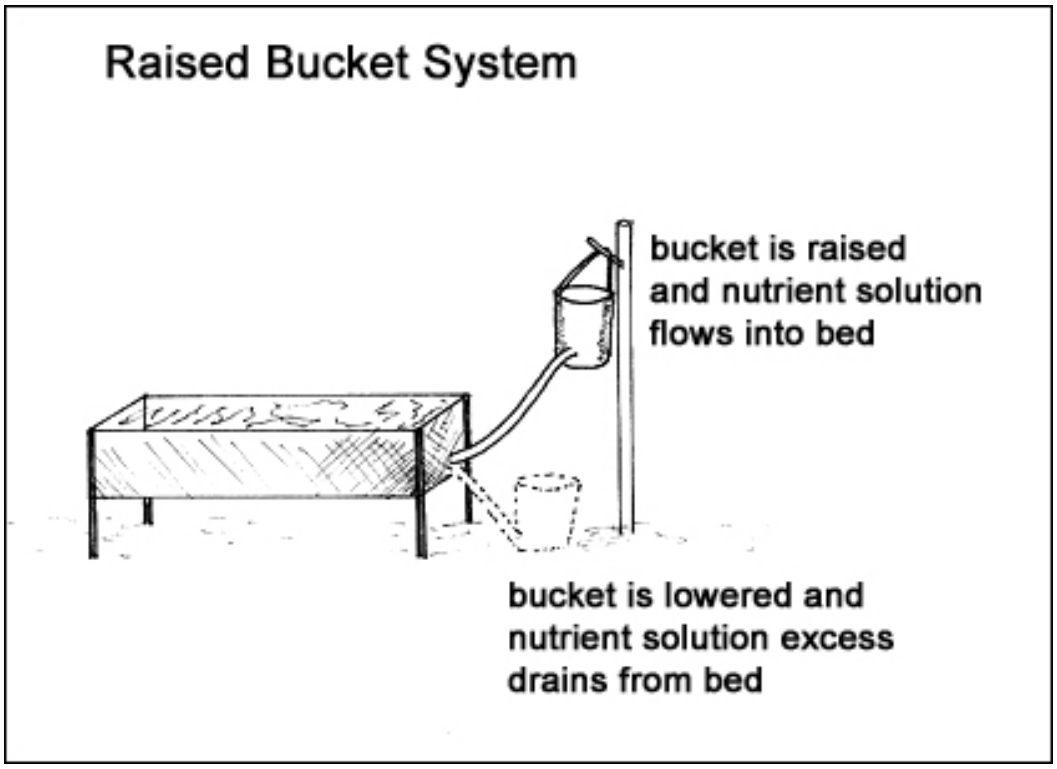
The plant is planted into a pot of inert media. The pot is then placed inside a bucket or water holding container. Nutrient solution is then put into the container so the pot sits partially in the solution. The nutrient solution will be absorbed through holes at the bootom of the pot and sucked up (this is called capillary action).

The depth of nutrient solution will depend on how much the plant tolerates and requires water; and the type of media being used (ie If it is well aerated or more absorbent).



## Ebb and Flow System

The ebb and flow is a versatile system that floods the grow tray with the nutrient solution for a short period and then drains the solution back into the reservoir using a submerged pump and timer. The timer cuts in several times a day and as it cuts in the nutrient solution washes onto the tray, then as it cuts out the solution drains back into a reservoir. The frequency is dictated by the type of plants being grown and the growing medium used. Several types of growing media such as perlite, rockwool, gravel or grow rocks can be used in this system. It is advisable to use medium with greater water retention abilities such as rockwool as the incidence of root dehydration during power outages is lessened.




## Drip System

Drip systems are simple to operate, very widely used and the most popular system worldwide. A submersed pump is controlled by a timer: when the timer turns on the nutrient solution drips onto the base of each plant using a drip line. There are two types of drip systems: recovery and non-recovery systems.

- The **recovery system** is where the excess (drained off) nutrient solution is recovered in a reservoir and then recycled. This system uses a less expensive (and less precise) timer than the non-recovery system. It is more efficient in that it recycles nutrients and due to this does not need to be as precise as the non-recovery system. However, this system needs to be carefully monitored to ensure the nutrient solution doesn't vary too much in pH and strength due to the recycling process.
- The **non-recovery system** does not collect or recycle the excess nutrient solution. It needs to be more precise than the former system to ensure that the plant gets the correct level of nutrient solution and that the runoff is kept to a minimum. This system does not have the same level of maintenance as the former system as the nutrient solution is not recycled so pH and nutrient levels should always be correct.

## N.F.T. system

N.F.T. systems do not use a growing medium. Instead the plants are supported by a basket and the roots dangle in the nutrient solution. There is a constant flow of nutrient solution which means a timer is not required for the submersible pump. The nutrient solution is pumped into the growing tray using a tube it flows over the roots of the plants, and then drains back into the reservoir. This is an inexpensive method as it does not require the expense of replacing the growing medium for each successive crop. Roots dry out rapidly however during power outages or equipment failure when the supply nutrient solution is interrupted.

## Aeroponic System

The **aeroponic system** is probably the most high-tech type of hydroponic gardening. Like the previous system, the plants are suspended in the air. The root system is periodically (every few minutes) misted with the nutrient solution using a timer and nutrient pump on a short cycle for a few seconds at a time. Due to root exposure in this system the roots can dry out rapidly during power outages or equipment failure.

## HYDROPONICS – A GLOBAL INDUSTRY IN THE 21ST CENTURY

Commercial hydroponics is a successful and rapidly expanding industry. Industry growth has been particularly dramatic in the last fifteen years. In the early 1990s there were around 5000 hectares of commercial hydroponic production worldwide. By 2001 there were an estimated 20,000 to 25,000 hectares under hydroponic production, and now (2005) it is estimated 50-60,000 hectares are producing hydroponic crops. This strong growth in global commercial production is expected to continue over the next few years.

Production is focused in affluent countries such as the Netherlands, Spain, Canada, Japan, UK, US, New Zealand and Australia, and also to countries that have access to these markets such as Mexico and China.

Worldwide, there are a limited number of crops grown hydroponically. Tomatoes, cucumbers, lettuce, peppers, and cut flowers (including roses, gerberas, carnations, chrysanthemums and lisianthus) are the most important commercial crops.

In most countries, most hydroponic crops are grown in greenhouses, the exception being Australia where more than 50% of hydroponic production takes place outdoors (due to the high proportion of lettuce grown).

The major producer of commercial hydroponic crops in the 21st century is the Netherlands. Holland has a total hydroponic production area of 25,000 acres and accounts for 50% of the value of fruit and vegetable production in the country; the produce being mainly grown for the export market. Crops include cucumbers, tomatoes and peppers. In Holland, nearly all greenhouses have converted to rockwool and NFT culture, due to soil depletion, salinisation, a build-up of soil-borne diseases, high water tables and good economic returns.

Other major producers are Spain, Canada and France. Australia is ranked as the tenth major producer in the world, and the leading producer of fancy lettuce. Expansion in the US has been slower; in 1998 the US ranked as the sixteenth largest producer, although a recent surge in large commercial installations is likely to boost production.

The most popular systems worldwide are NFT and rockwool culture, although other systems are used for commercial production. In all countries systems are moving towards recirculation, due to the potential environmental problems caused by run-to-waste systems.

## HYDROPONICS – IS IT AS GOOD AS GROWING PLANTS IN THE SOIL?

There is no real difference as far as a plant is concerned in the nutrients it receives from hydroponics compared with normal soil gardening or organic gardening. For all three growing methods:

- The plant takes in and uses the same molecules from the air.
- The plant needs the same temperature, light and moisture conditions.
- The plant absorbs the same plant nutrients into its roots.

The only real differences are in the way the nutrients are supplied to the plant:

- With organic gardening, nutrients are supplied as complex chemical molecules, which are from the tissues of decomposing animals or plants (or their by-products). These complex molecules are broken down in the root zone to form much simpler compounds which are then able to be taken in by the roots of the plant.
- With soil gardening, the soil contains both simple and complex compounds. Fertilisers applied are both simple and complex compounds. The simple compounds are absorbed directly. The complex compounds are broken down and then absorbed.
- With hydroponics, nutrients are applied as the same simple chemicals that occur in soil, or which organic compounds in soil break down to form. They are in a ready-to-use state as soon as applied.

## Assignment 1

### Question 1

Prepare six different resource file entries (i.e. listings of contacts), and submit with this assignment (no more and no less than six).

### Question 2

Define hydroponics in your own words. (Write 1 sentence only).

### Question 3

List one or two main chemicals that can be used to provide each of the following in hydroponic nutrients:

a) Nitrogen

b) Phosphorus

c) Potassium

### Question 4

What are the most common types of manual and automatic systems used in both commercial and home hydroponics today? Give 4 or 5 examples, and draw a labelled sketch to explain how each works.

### Question 5

List any plants you have grown in hydroponics (up to 5), and beside each note the type of system you used (e.g. Tomatoes - manual, trough with gravel).

List types of hydroponic systems (e.g. NFT channel, gravel bed, etc.), which you have previously encountered (if none, say “none”).

# Congratulations on finishing this section.

Now start the next section on the next page