Soilless culture

- All methods of growing plants without the use of soil as a rooting medium.

- The roots grow either directly in pure nutrient solution or in a porous material (substrate) which contains nutrient solution in part of its pores.

Nutrient solution

A diluted water solution containing all* essential nutrients in form of inorganic ions or soluble inorganic compounds.

* With the exception of iron, which is contained in form of an organic chelate.

Electrical conductivity (EC)

A quantity indicating the ability of the solution to conduct electric current.

The Electrical Conductivity (EC) is defined as specific conductance (conductance per volume unit of a solution).

The electric conductance (C_a) is defined as the reciprocal of the electric resistance, R:

$$Ca = 1/R$$

The EC is measured in dS m^{-1}.

(1 dS m^{-1} = 1 mS cm^{-1} = 1mmho cm^{-1})

Electrical conductivity (EC)

- The ability of a water solution to conduct the electric current is a result of the presence of ions.
- Consequently, the more ions are diluted in the solution the higher is its ability to conduct electric current.
- Thus, the EC indicates the total ionic concentration in the nutrient solution.
- However, the EC can not provide any information as to which specific ions are present in the solution.

Electrical conductivity (EC)

The EC can be quickly and easily measured in the greenhouse by means of robust, portable instruments.

Therefore, it is widely used to estimate the total salt concentration in nutrient solutions.

The pH

A number indicating the concentration of hydrogen ions (H^+ or H_3O^+) in a nutrient solution in a logarithmic scale (1 – 14).

The pH of a nutrient solution is very important for plant nutrition because it influences the solubility of some nutrient ions as well as the chemical equilibrium between different ionic and nonionic forms of some nutrients.

Substrate

Any porous material lacking phytotoxicity, which can substitute the soil in those functions, which are essential for plant growth.

Chemically inactive or inert substrates:

No ion exchange capacity

Chemically active substrates:

There are ion exchange sites on their surface

Various types of substrates for soilless culture

The substrates substitute the soil in the following functions related to plant growth:

1. To supply water
2. To supply nutrients
3. To supply oxygen
4. To provide support

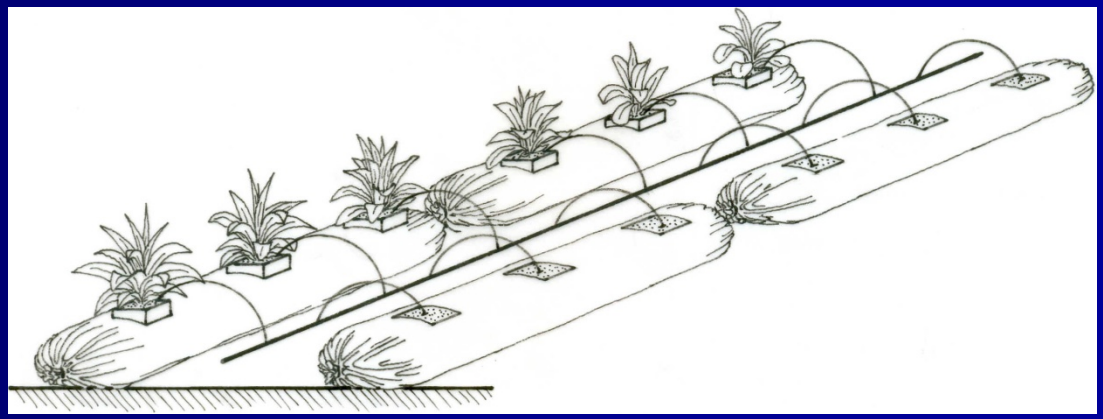
Soilless culture systems

- Classification according to the method of managing the drainage solution
- Classification according to the rooting medium
- Classification according to the architecture of the system and the construction materials

Open soilless culture systems

The surplus solution released from the root environment after its supply to the crop runs off.

Open soilless culture systems



Closed soilless culture systems

The surplus nutrient solution released from the root environment after its supply to the crop is collected, replenished with nutrients and water and reused.

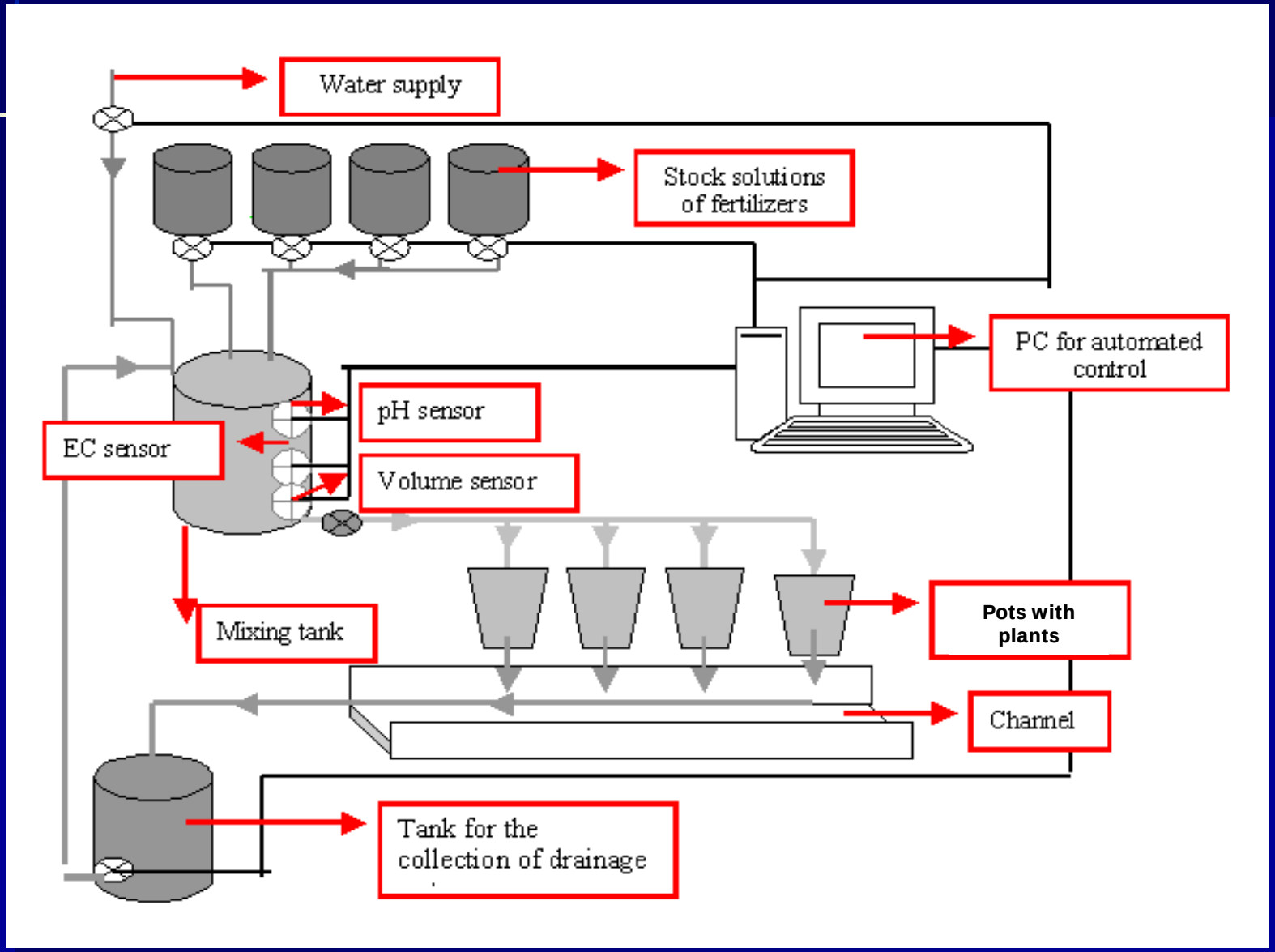
Tomato grown in a closed hydroponic system

A strawberry crop grown in a closed-loop hydroponic system

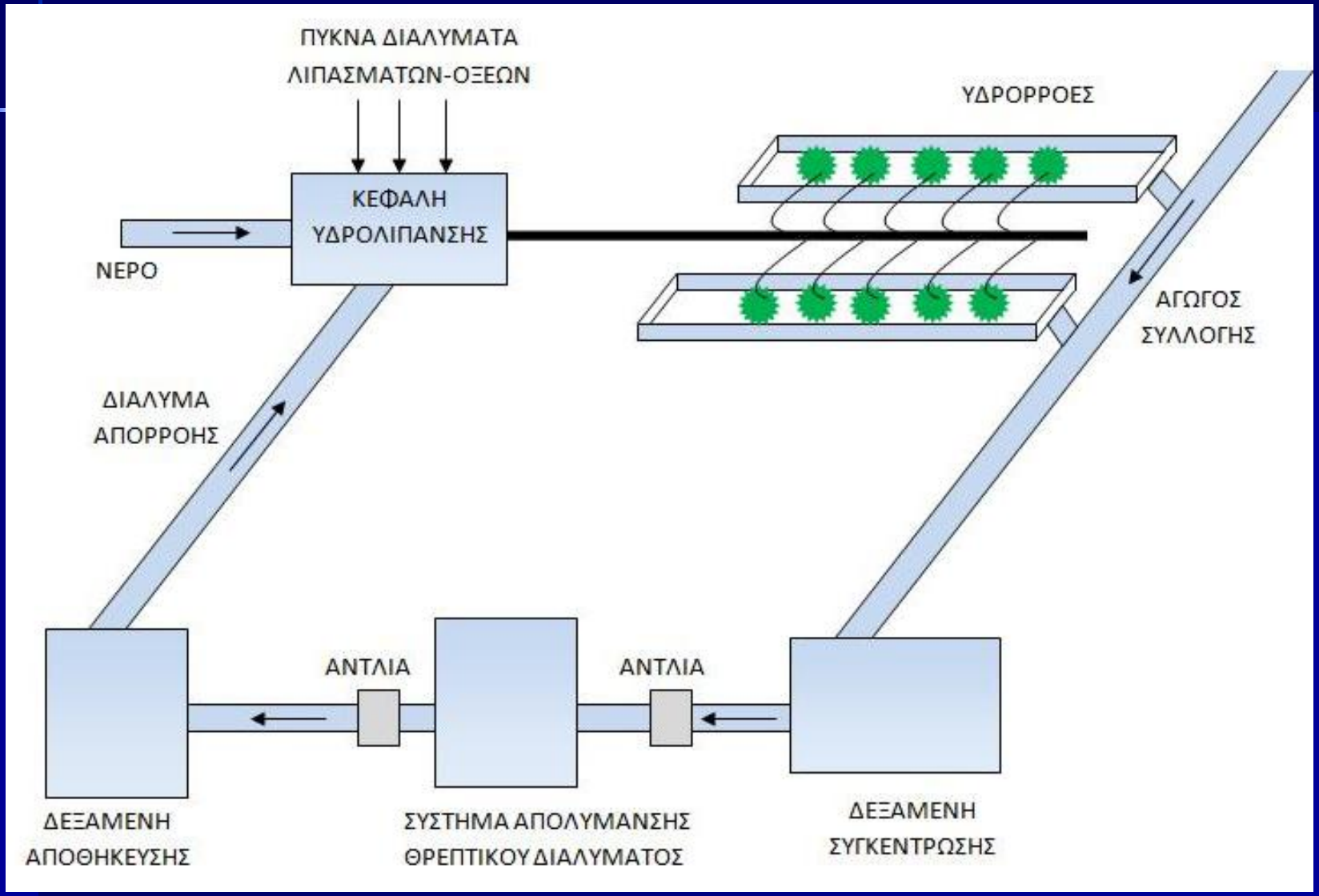
Channels used for drainage solution collection

Collection of the drainage solution

Schematic representation of a closed hydroponic system



Components of a closed soilless culture system



Classification of soilless culture systems according to the rooting medium

- **Hydroponics**
  - Water culture
  - Cultivation on inert aggregates
- **Soilless cultivation on chemically active substrates**
  - Inorganic chemically active substrates
  - Organic chemically active substrates

Hydroponics

Methods of soilless culture involving chemically inactive substrates or pure nutrient solution as growing media

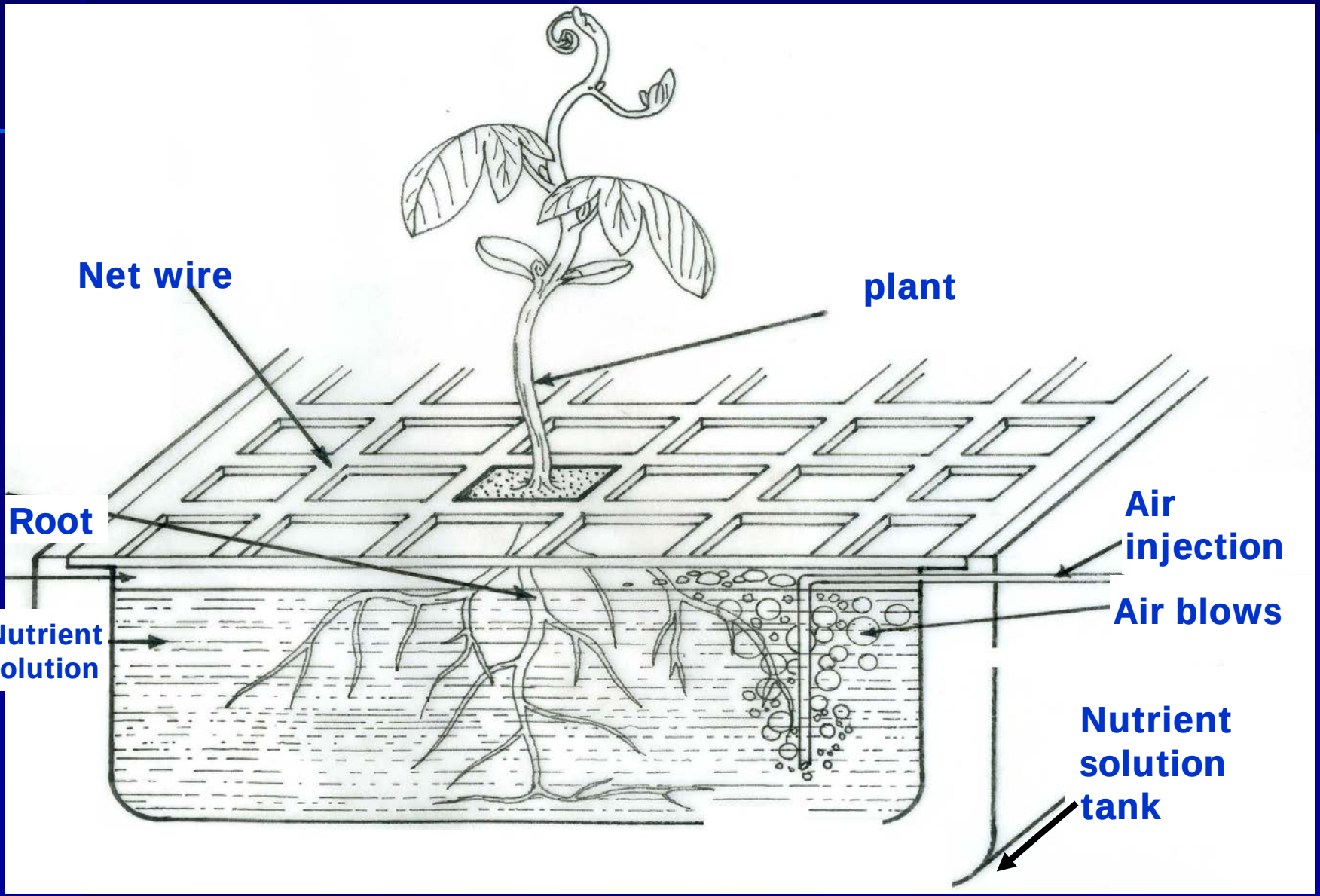
Definitions

Geoponics: **Geo = soil** **ponics = ponos = labor**	**working with the soil**
Hydroponics: **Hydro = water** **ponics = ponos = labor**	**working with the water**

Water Culture

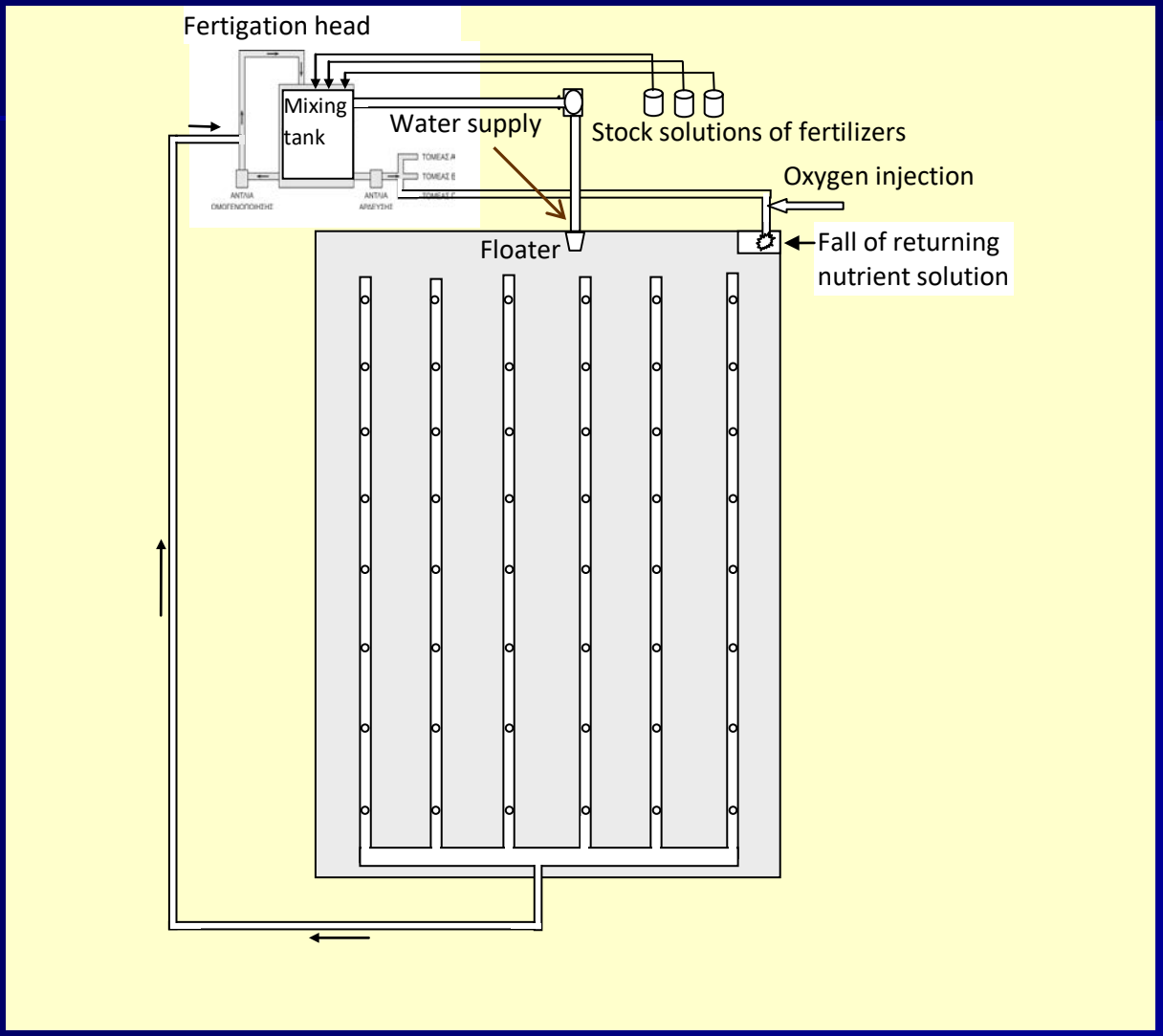
- All methods of growing plants without the use of any porous material as a rooting medium.
- The nutrient solution may be ***stationary*** or ***recirculating.***

Schematic representation of stationary water culture

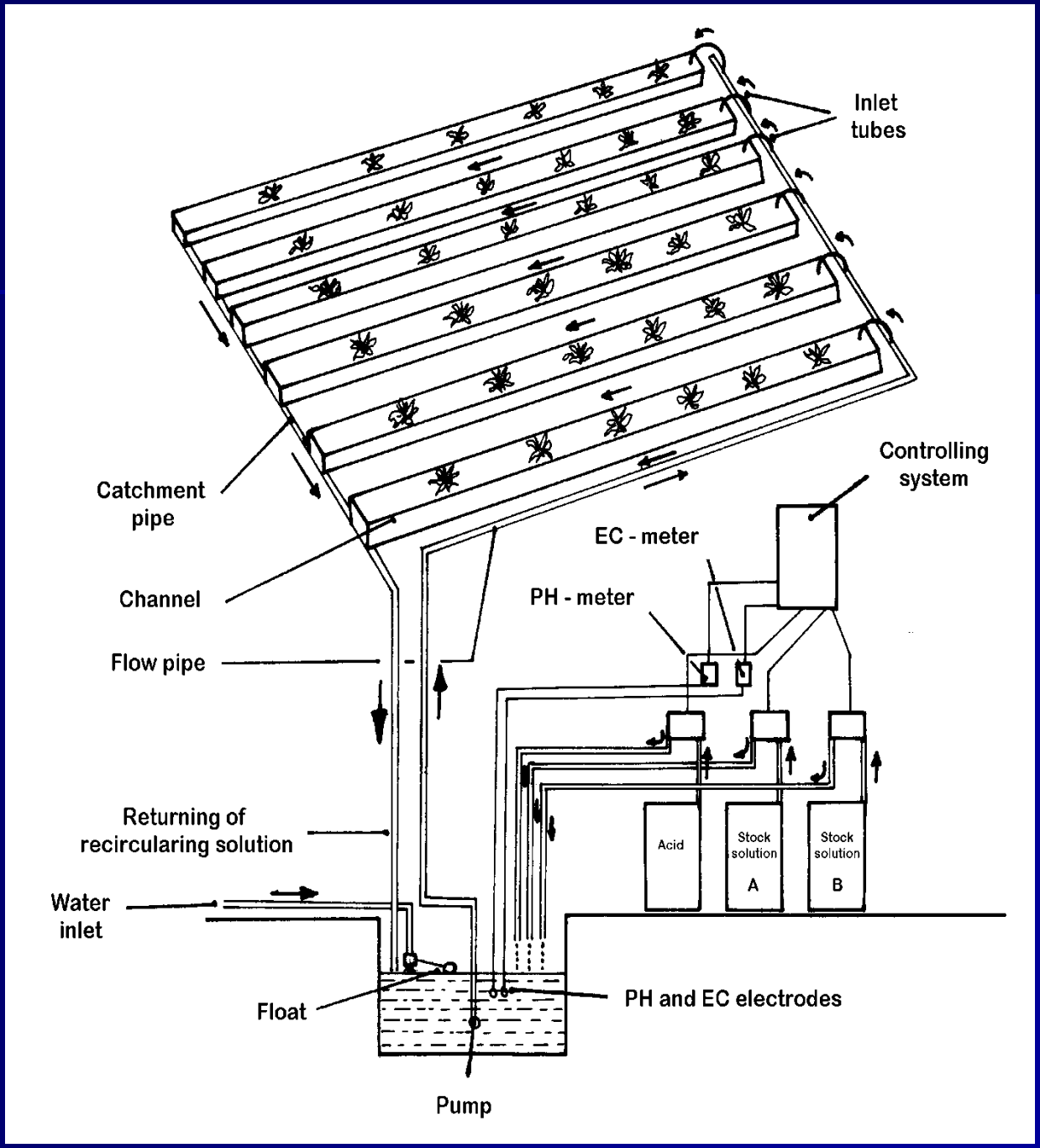


Commercial float system

Schematic representation of a float system



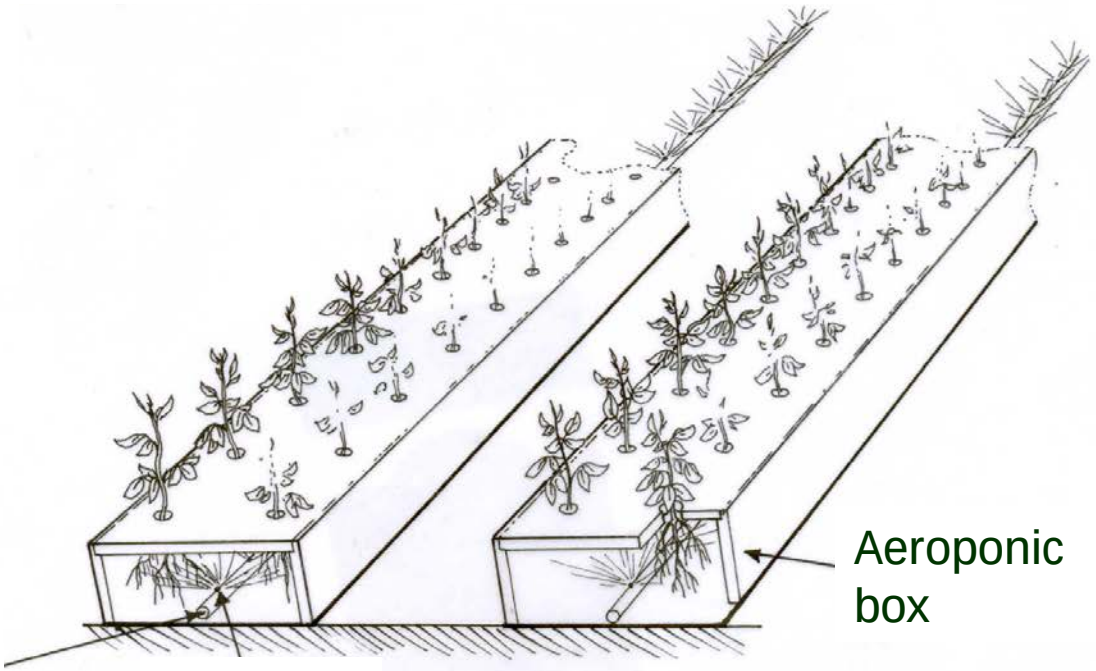
Schematic representation of a crop grown in a shallow stream of recirculating nutrient solution (NFT)



Roots of tomato grown in an NFT-system

Lettuce grown in a commercial NFT system

Aeroponics



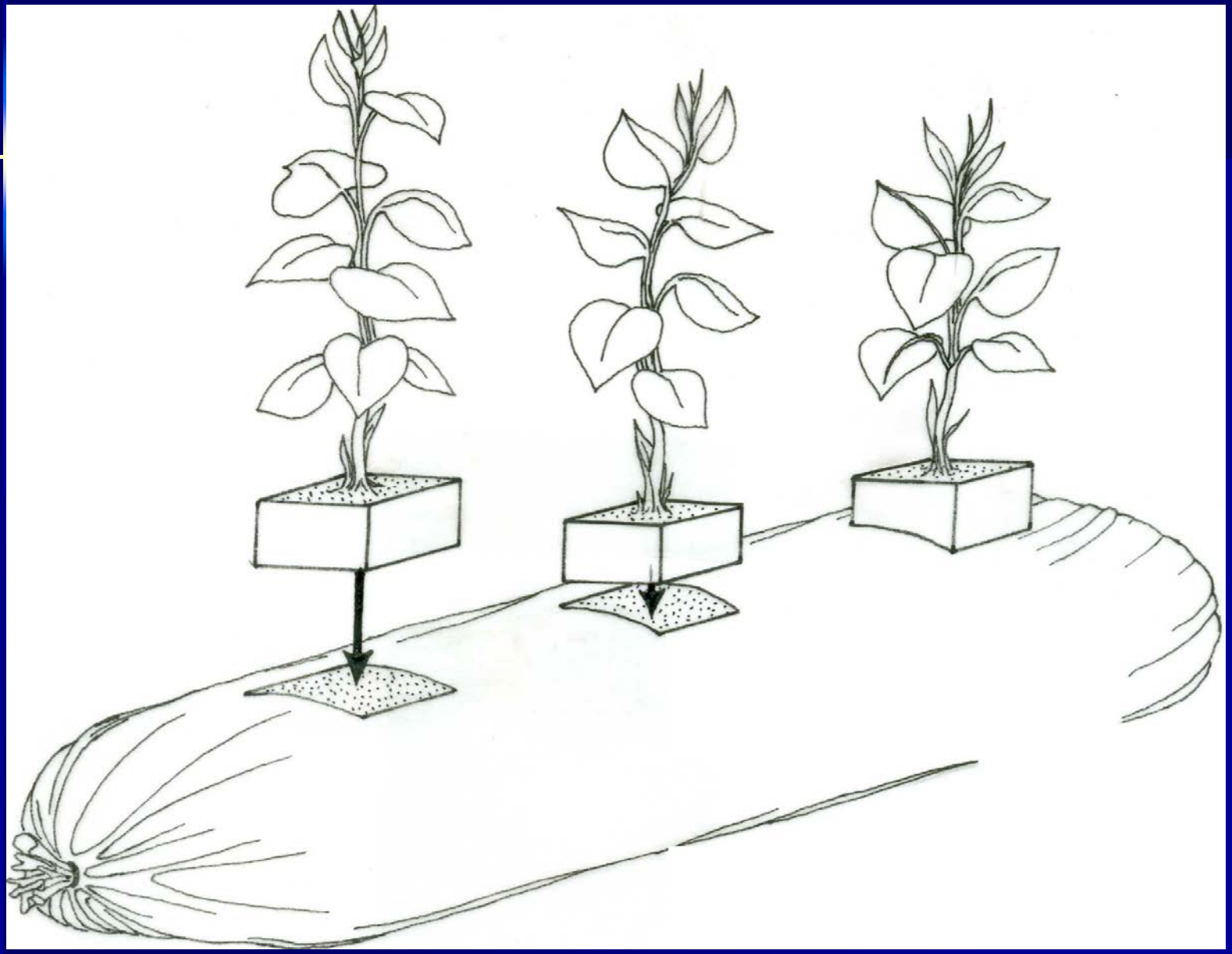
Lettuce in aeroponics

Tomato in aeroponics

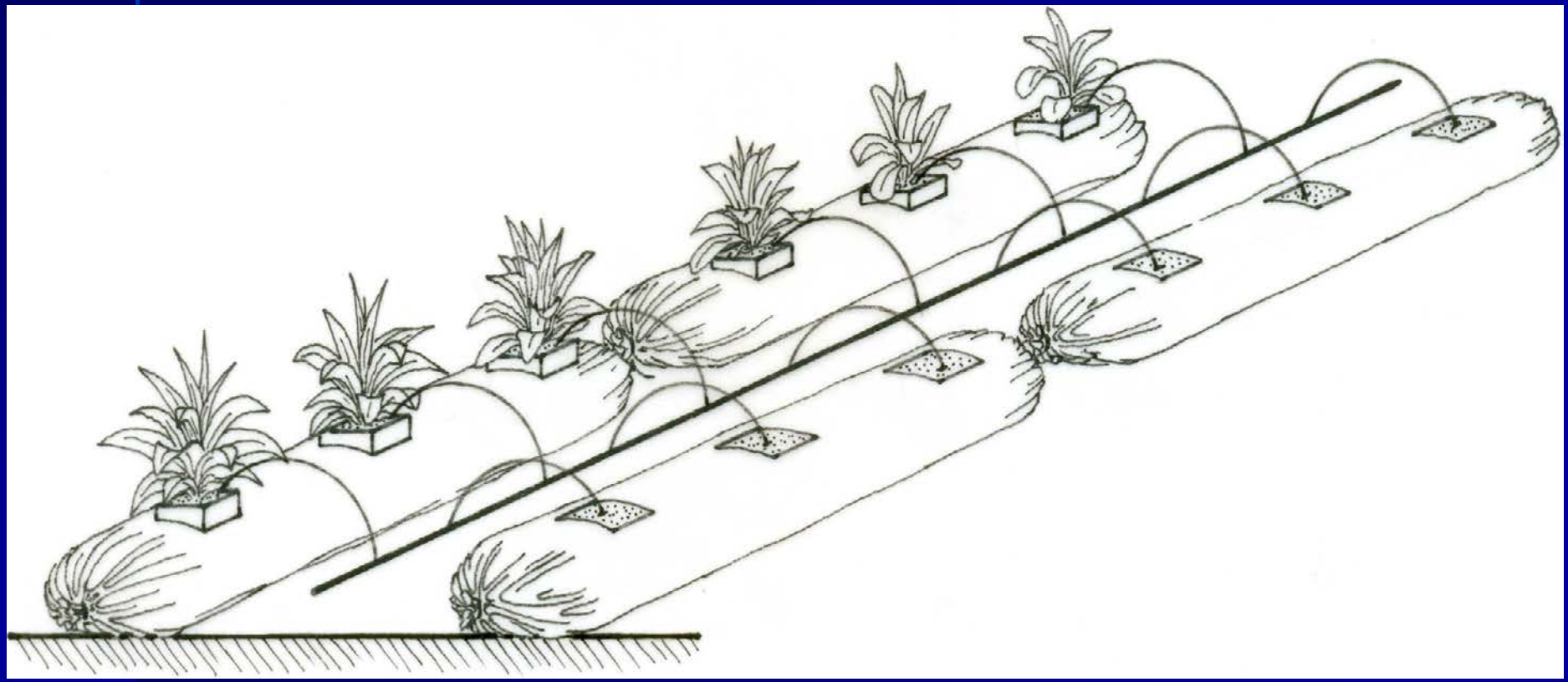
II. Systems involving an aggregate as growing medium

- Soilless culture in bags:
  - filled with a granular substrate
  - filled with slabs
- Soilless culture in pots
- Soilless culture in containers
- Soilless culture in channels filled with a substrate

Bag culture



Cultivation on bags filled with a granular substrate



Tomato grown in bags filled with perlite

Roses grown in bags with perlite

A bean crop grown on bags filled with pumice

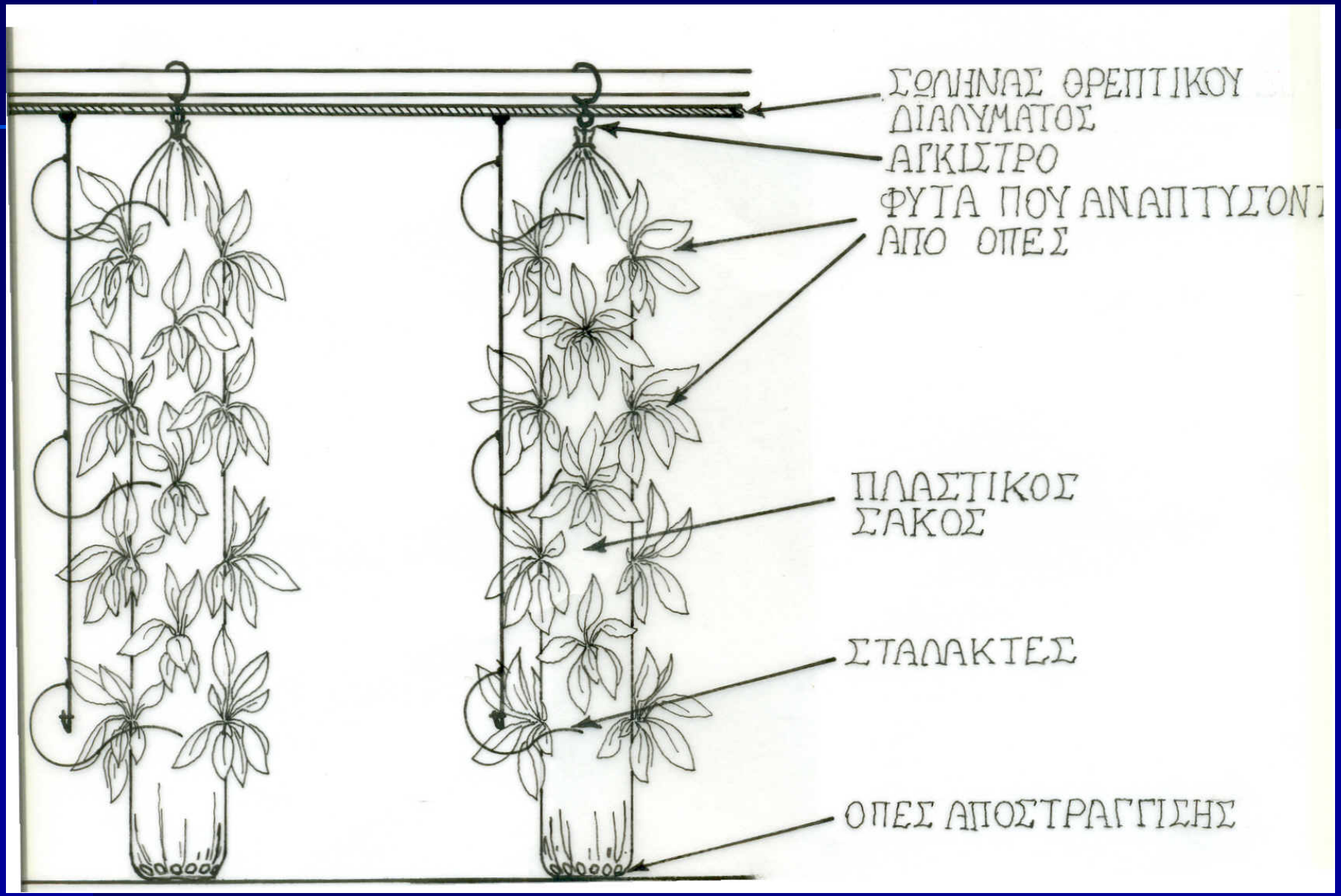
A cucumber crop grown on bags filled with pumice

Cucumber grown in bags filled with peat

Roses grown in coir

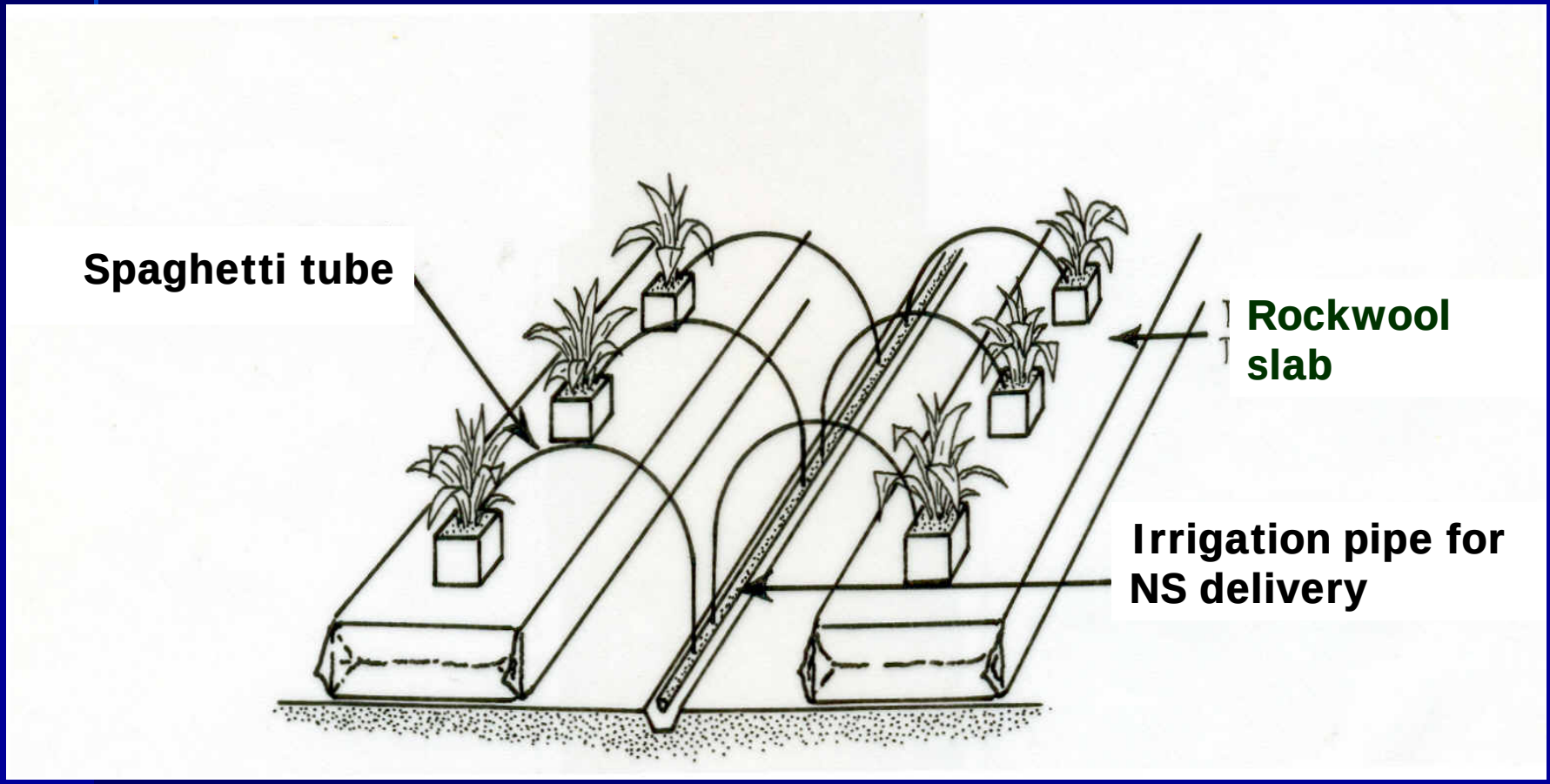
Strawberry grown in bags filled with coir

Vertical soilless culture in bags



Vertical soilless culture of stamnagathi in bags filled with pumice

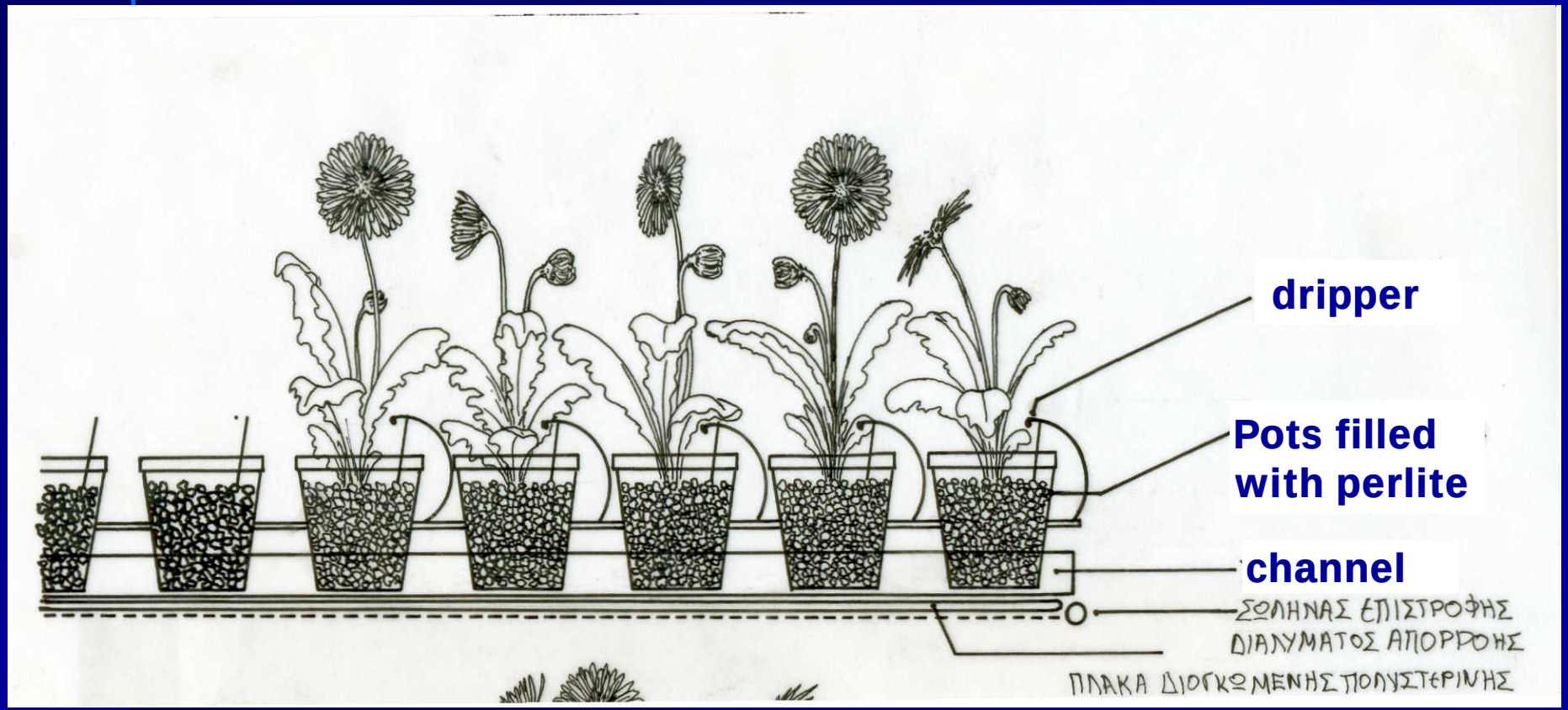
Cultivation on bags filled with rockwool slabs



Tomato grown on bags filled with rockwool slabs

Bean grown in rockwool slabs

Pots filled with a substrate



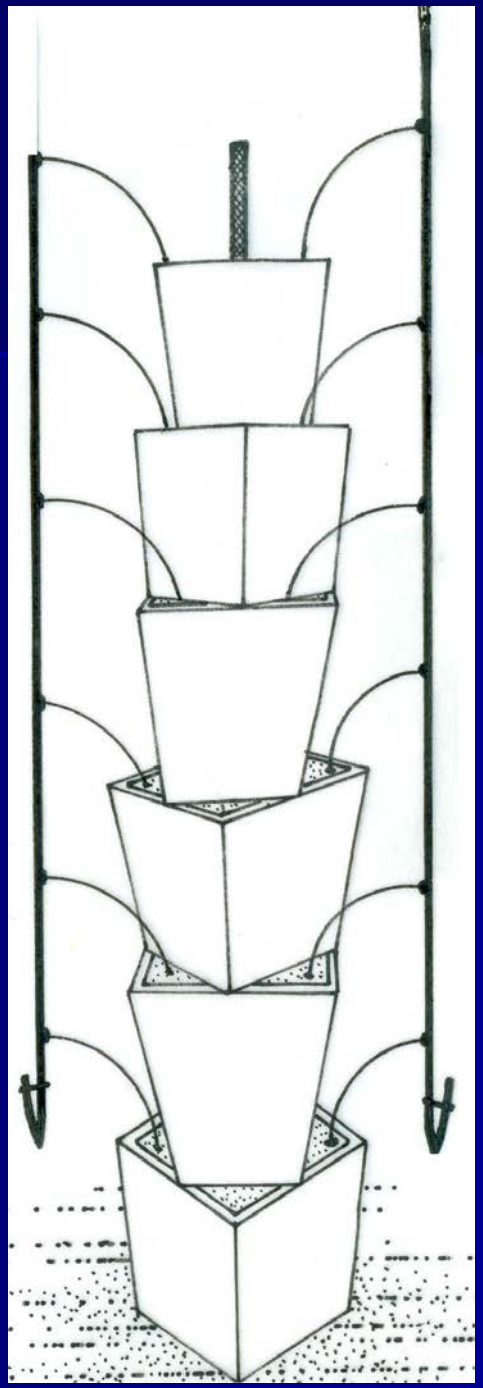
Sand culture of eggplant in pots

Tomato grown in pots filled with perlite

Carnation grown in pots filled with pumice

Cultivation of gerbera in pots filled with coir

Vertical soilless culture in pots



Tomato crop grown in containers filled with perlite

Anthurium grown in containers filled with an organic substrate

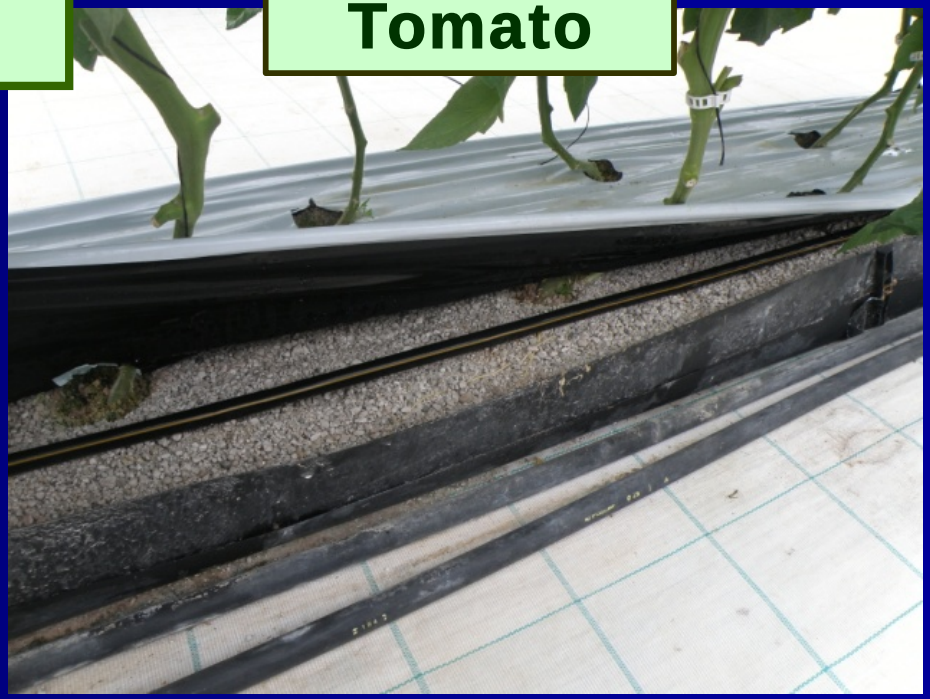
Tomato grown in channels filled with a locally produced granular substrate

Cucumber grown in channels filled with pumice

Lettuce

Cultivation in channels filled with pumice

Tomato



Cultivation in polystyrene channels filled with coir