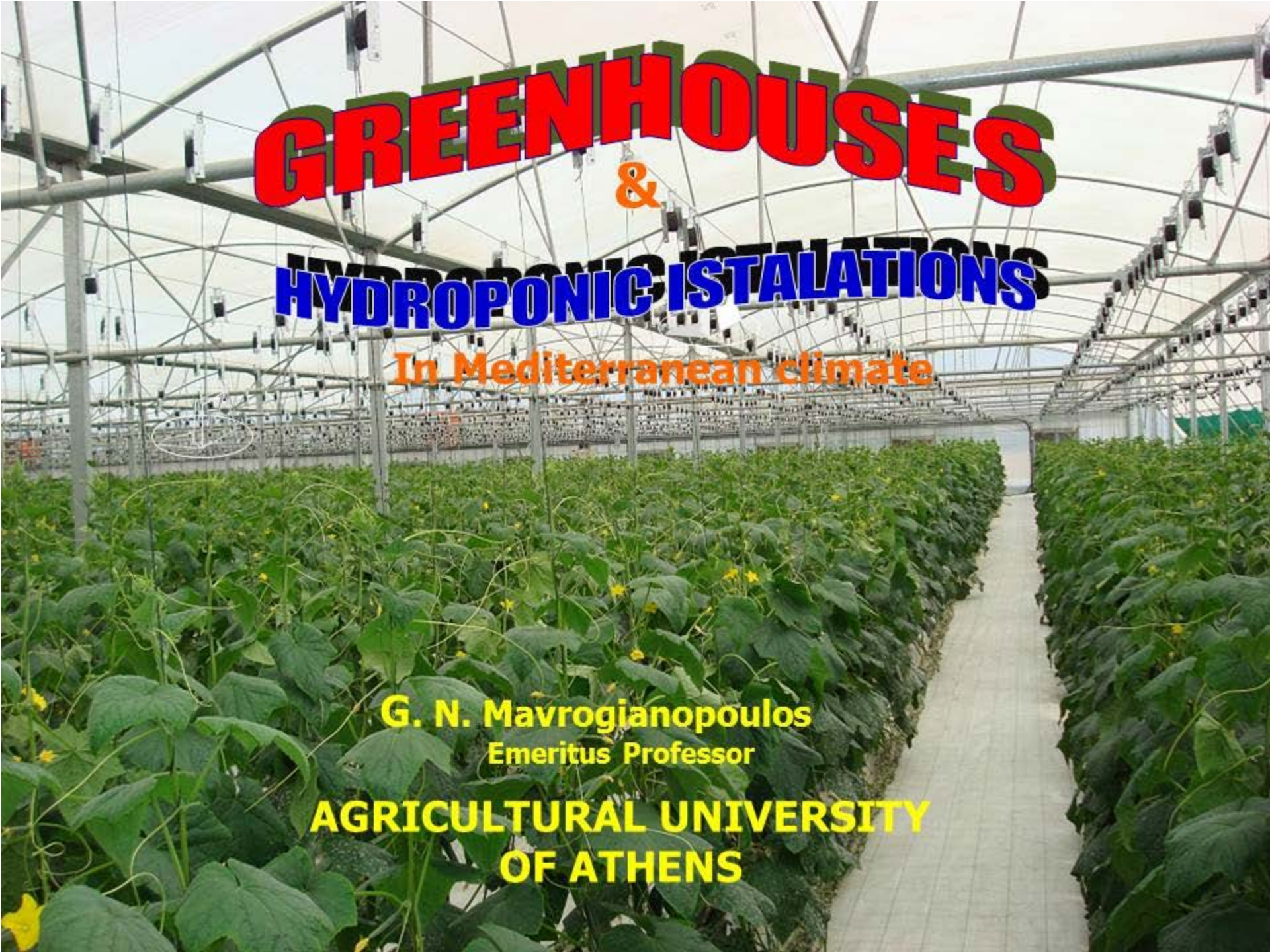
GREENHOUSES
&
HYDROPONIC ISTALATIONS
In Mediterranean climate
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Objective

To present some basic information for greenhouses and Hydroponics

INTRODUCTION

The UN organization for food and Agriculture (FAO) predicts that, **the world population** of 7 billion today **in 2030 will reach 8.3 billion** (18.5% increase)

Per capita consumption of fruit and vegetables during the last decade (worldwide) **shows an increase of 1% for vegetables**

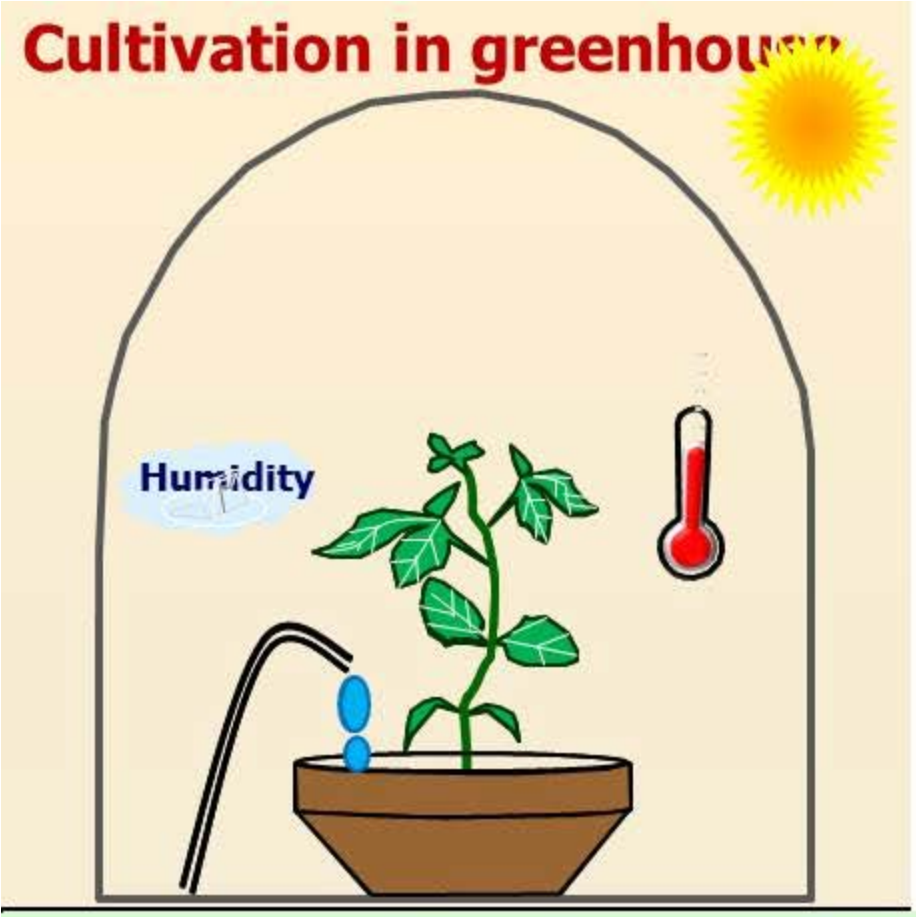
Therefore **food demand is expected to increase dramatically**

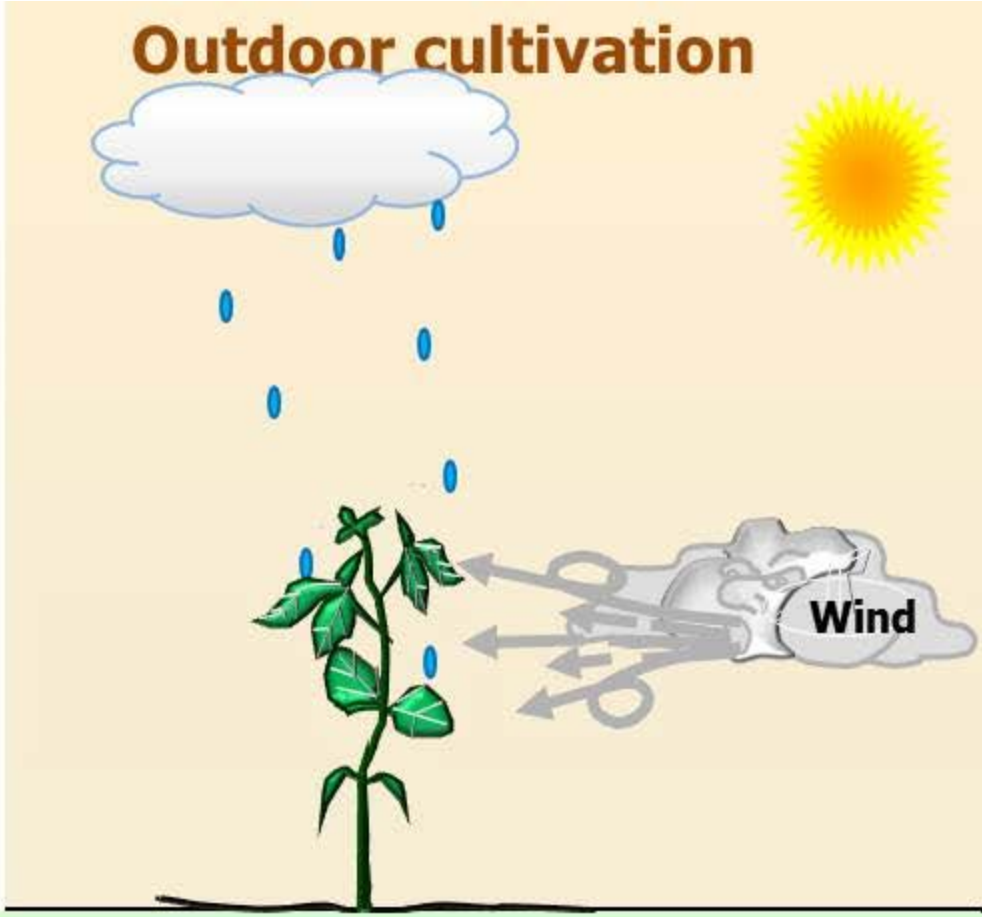
(FAO "Agriculture: Towards 2015/30").

Thus for fresh fruits and vegetables, it is expected to play a very important role in the international food trade, supplying vitamins, minerals and fibers to the humanity.

The use of the technologically developed agriculture (as is the production in modern greenhouses) **can provide a significant income to the grower**

Why Greenhouse ?





The greenhouse

- **protects against adverse weather events** and at the same time:
- **provides the ability to configure the environmental factors,** affecting growth and production of plants

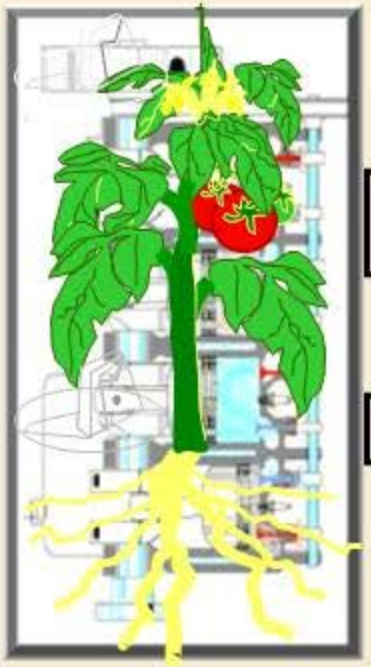
Why we need to configure the environmental factors for agricultural production ?

The machine production in agricultural business is the plant

PRODUCTION

Inputs | **Machine** | **Outputs**

Light
Heat
CO2
Water
Chemicals
other inputs



PRODUCTS

By-products

It works if

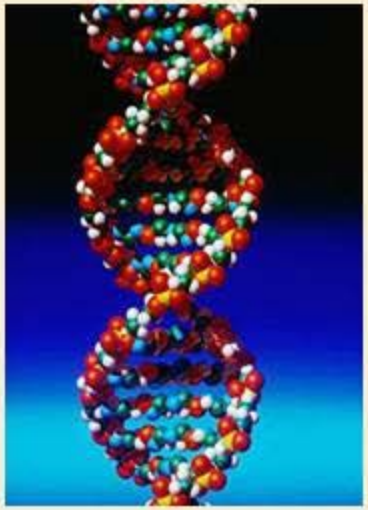
Input value + Value of machine & installations < Output value

Agricultural production therefore depends on:

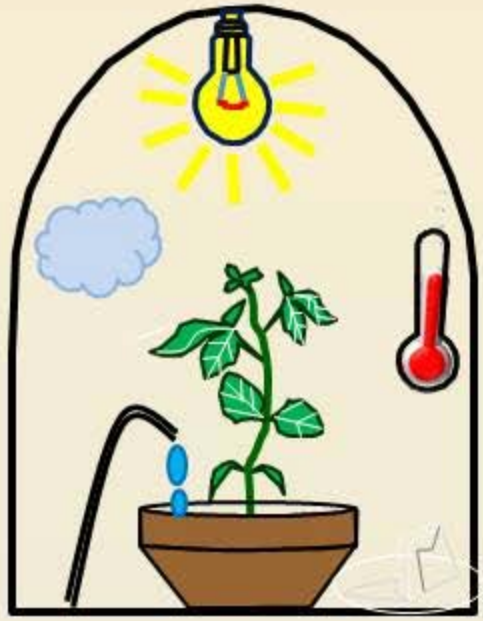
- hereditary potential

- environment in which they grow

Features of the machine



Inputs



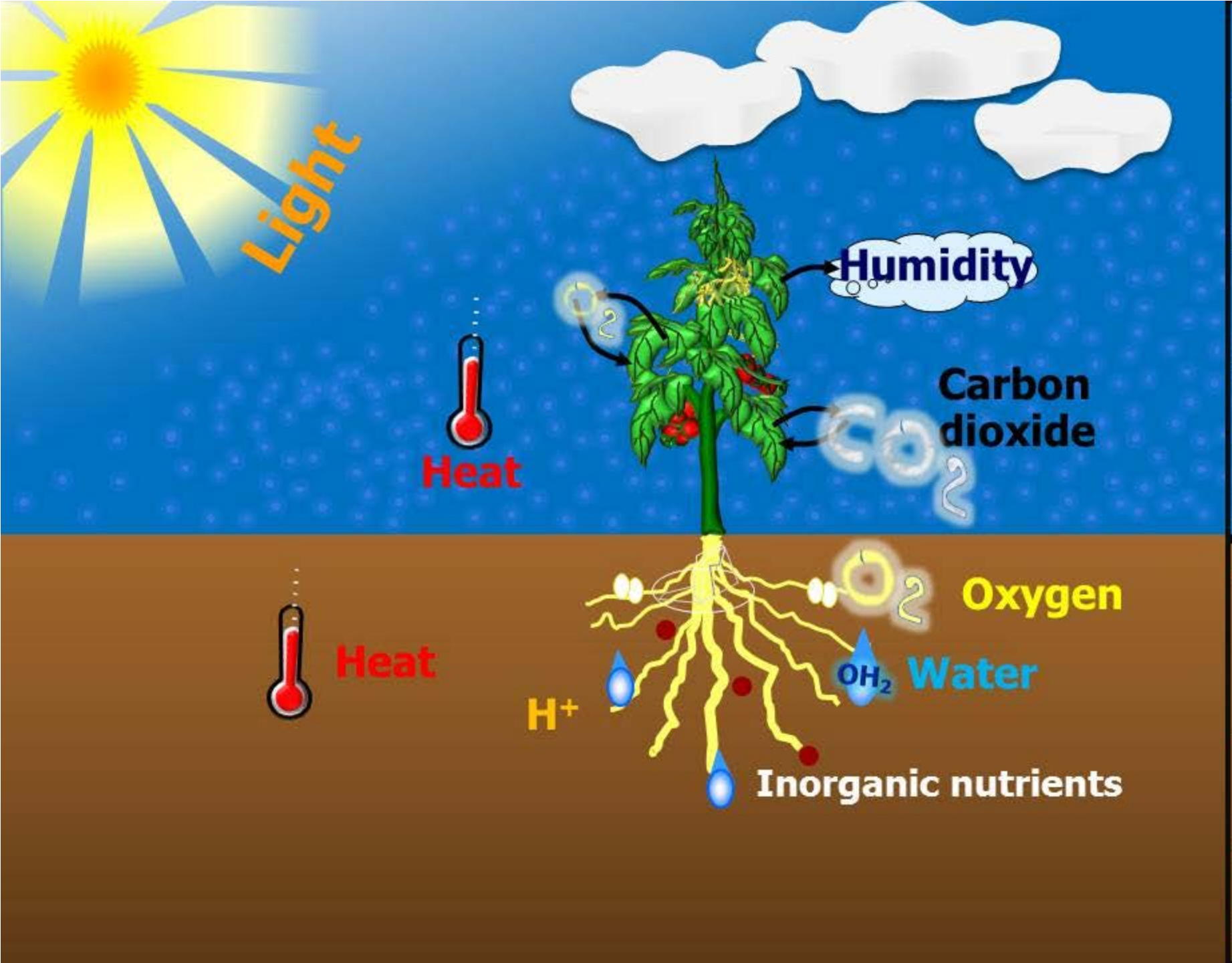
Therefore to achieve:

a successful production

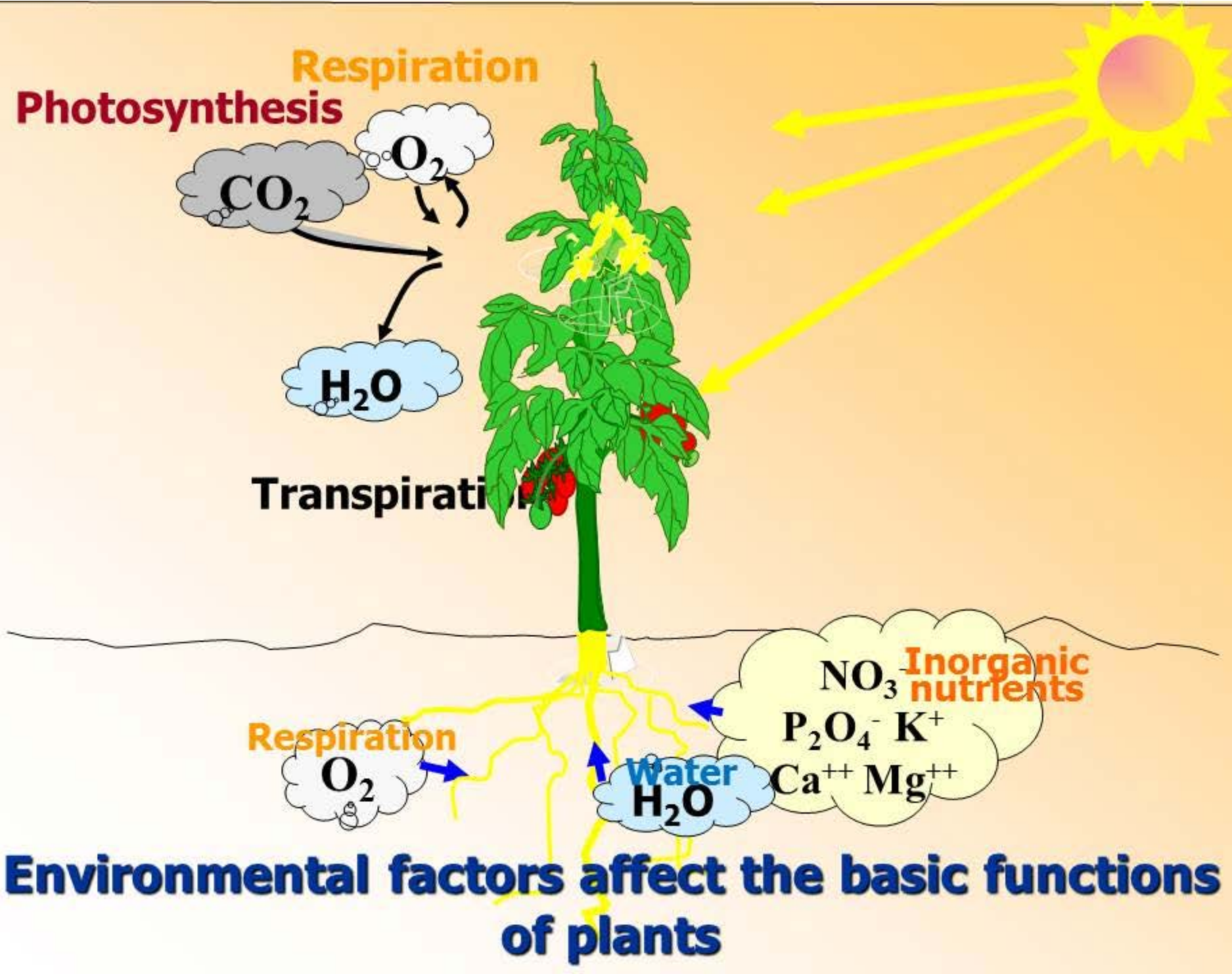
Are required:

1. **a variety or a hybrid with the desired characteristics**
2. **of environmental factors in the right direction**

Which are the factors of the environment ?


Light
Humidity
Heat
Carbon dioxide
Heat
Oxygen
Water
H+
Inorganic nutrients
Leaf's environment
Root's environment

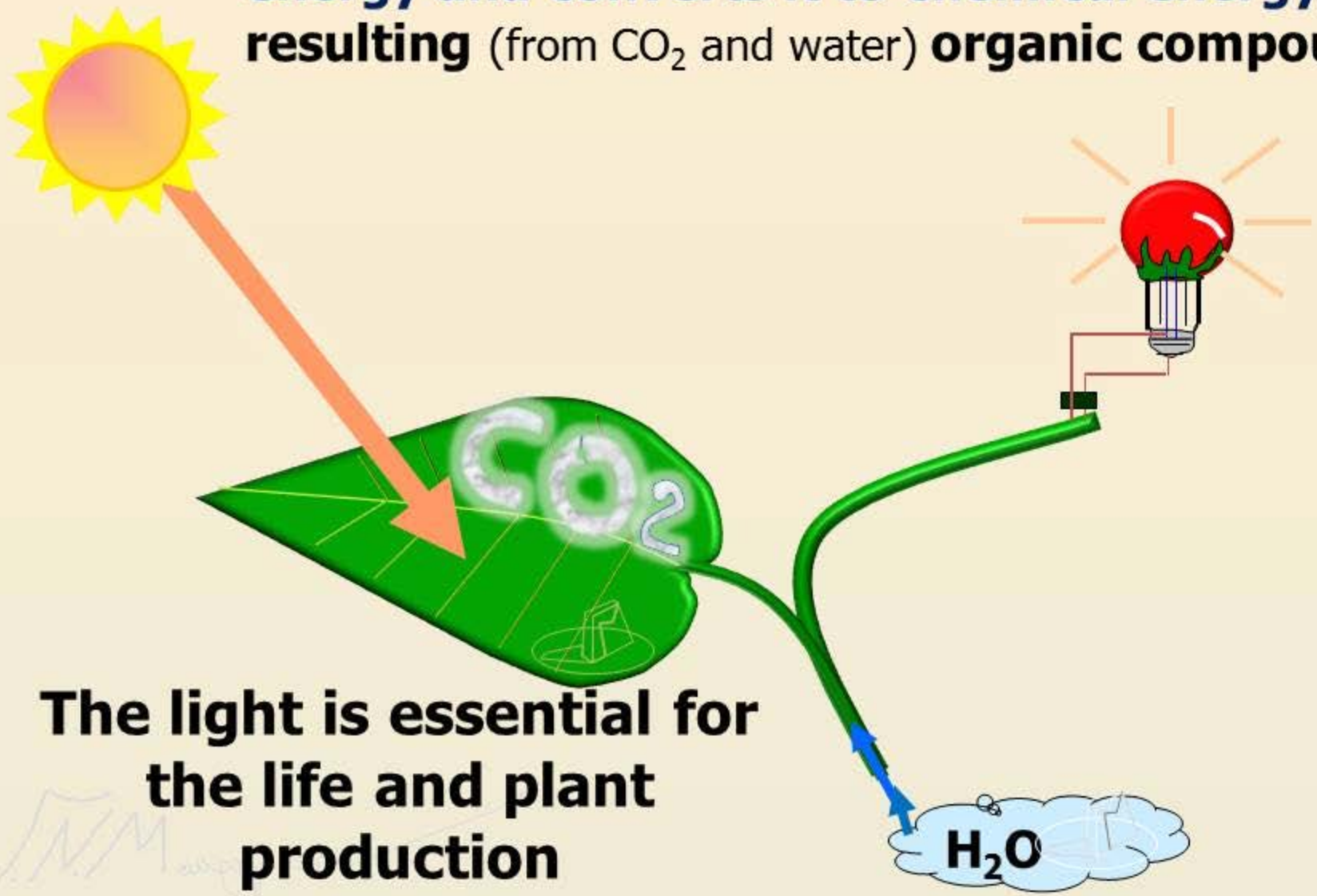
How the environmental factors affect the plant production ?



Environmental factors affect the basic functions of plants

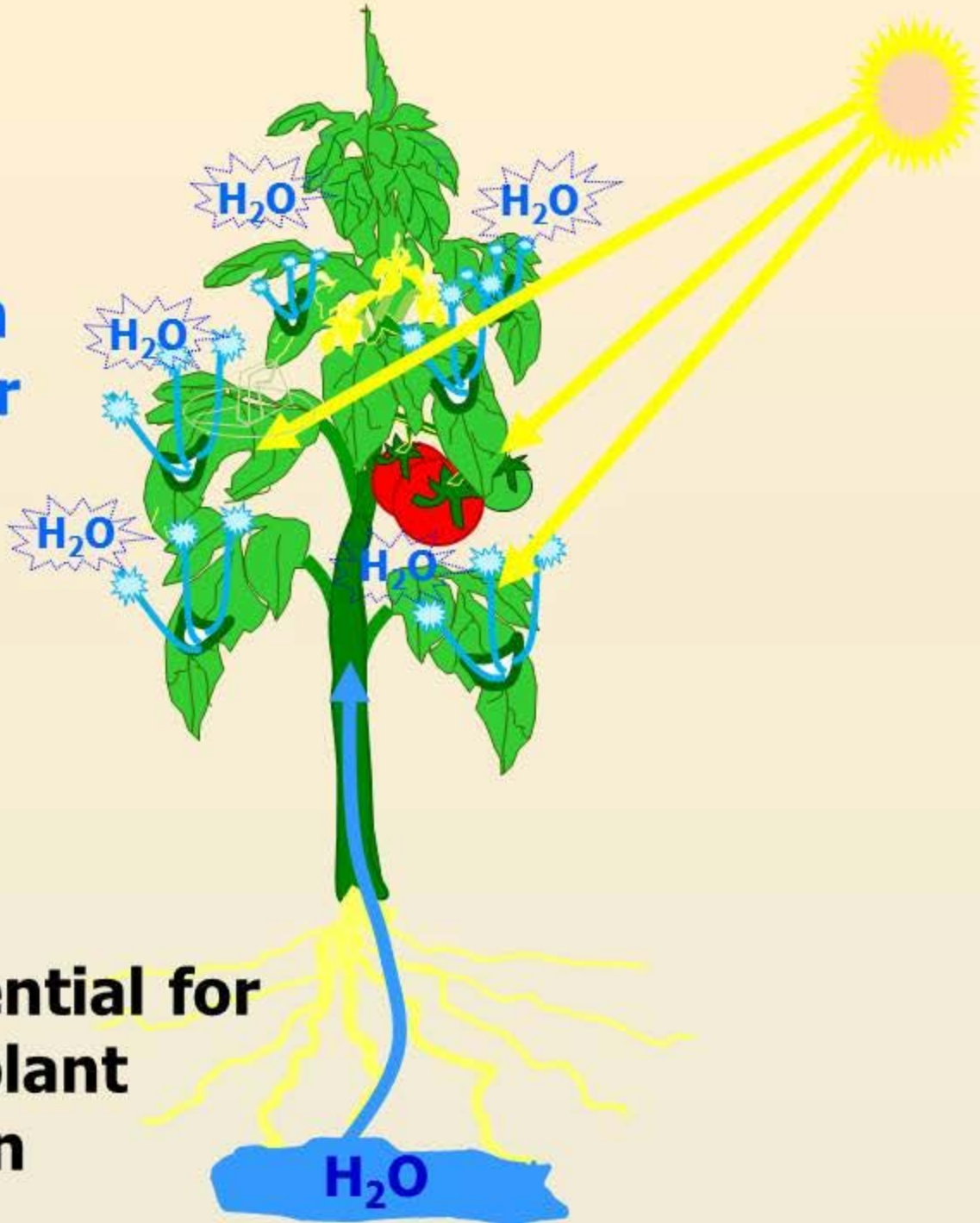
The plant is a solar collector !

With photosynthesis, the plant bind solar energy and converts it to chemical energy, resulting (from CO_2 and water) **organic compounds.**



The light is essential for the life and plant production

The transpiration evaporates water and adjusts the temperature of leaves



The water is essential for the life and plant production

Why is necessary the greenhouse to configure the environmental factors ?

With the greenhouse:

- we reduce the space to **become economically feasible** the **control of** the **environmental factors**

With the greenhouse then:

- **plant growth doesn't depend on random factors** but, by manipulations of the human factor
- **The production** method therefore **presents all the characteristics of industrial production**


However, the setting of environmental factors result in additional costs, derived from the:
• investment,
• energy consumption,
• labor and
• other resources

How then the extra costs of the production is alleviated ?

The extra cost, if properly conducted the use of the means of production**, is alleviated by:**

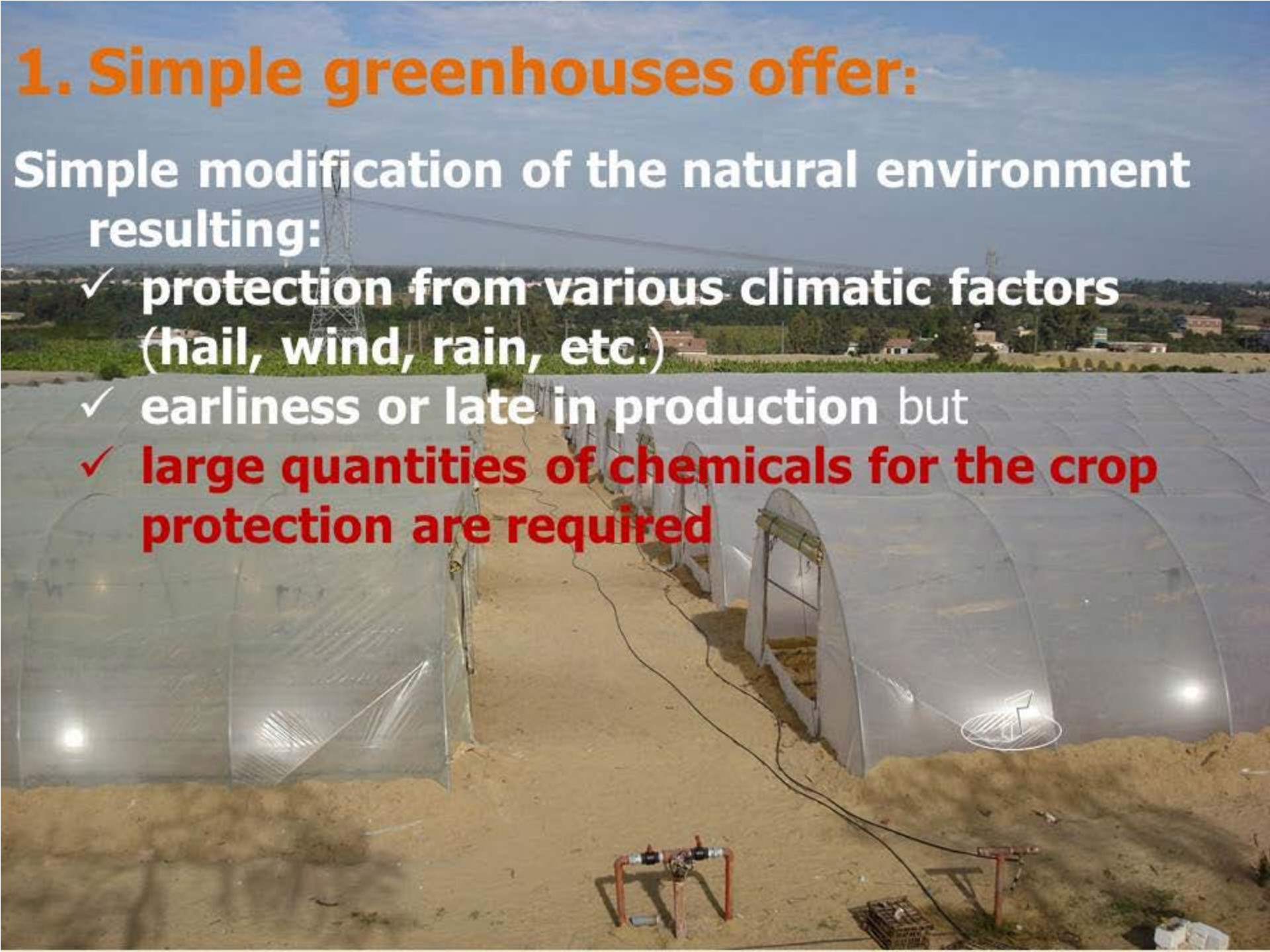
- **The favorable production time** (due to advantage in price of the product on the market)
- **Increased production**
- **The better quality**
- **Fewer expenses for plant protection**

All the greenhouses have the same features ?

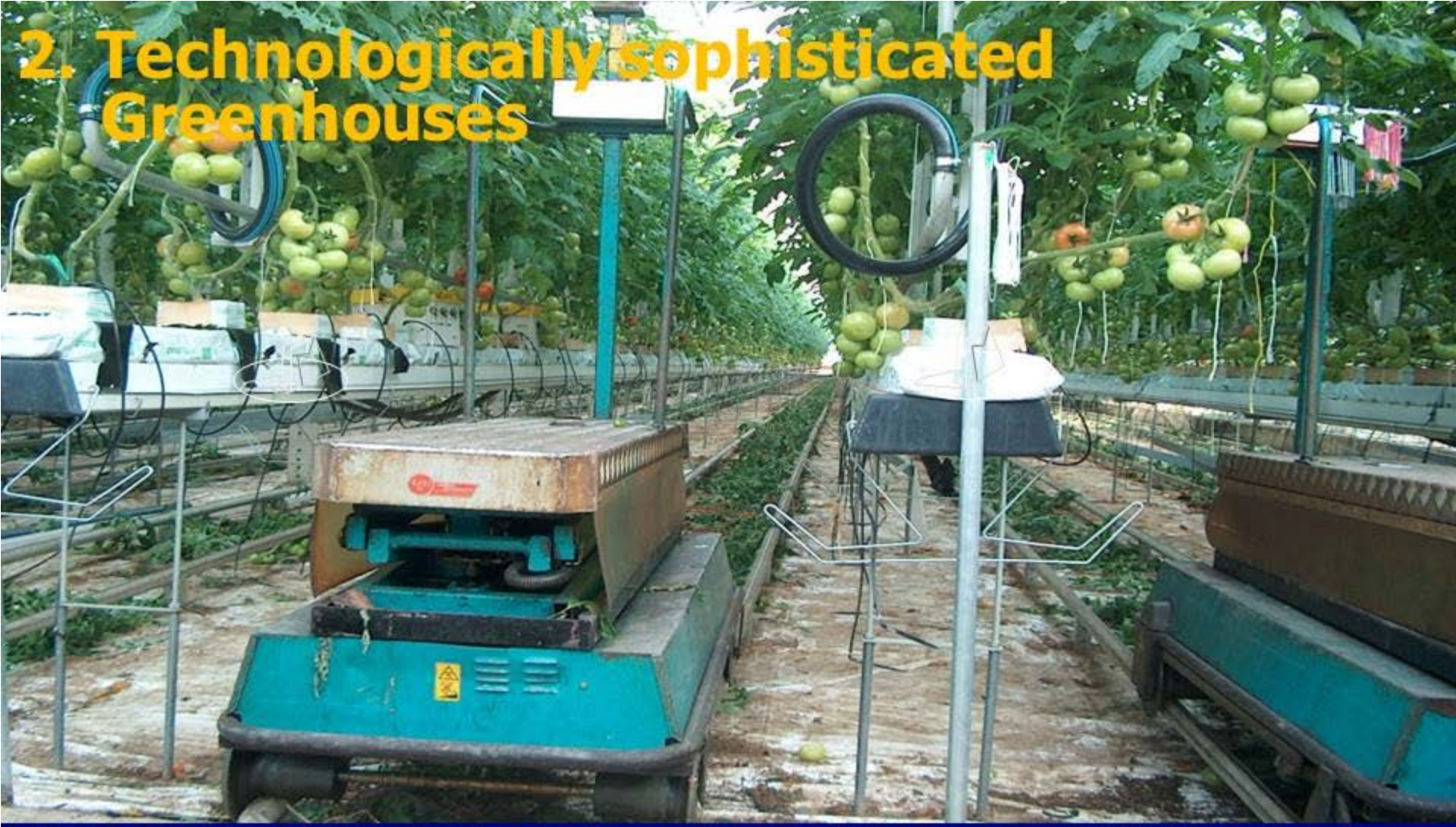
1. Simple greenhouses offer:

Simple modification of the natural environment resulting:

- ✓ **protection from various climatic factors (hail, wind, rain, etc.)**
- ✓ **earliness or late in production** but
- ✓ **large quantities of chemicals for the crop protection are required**

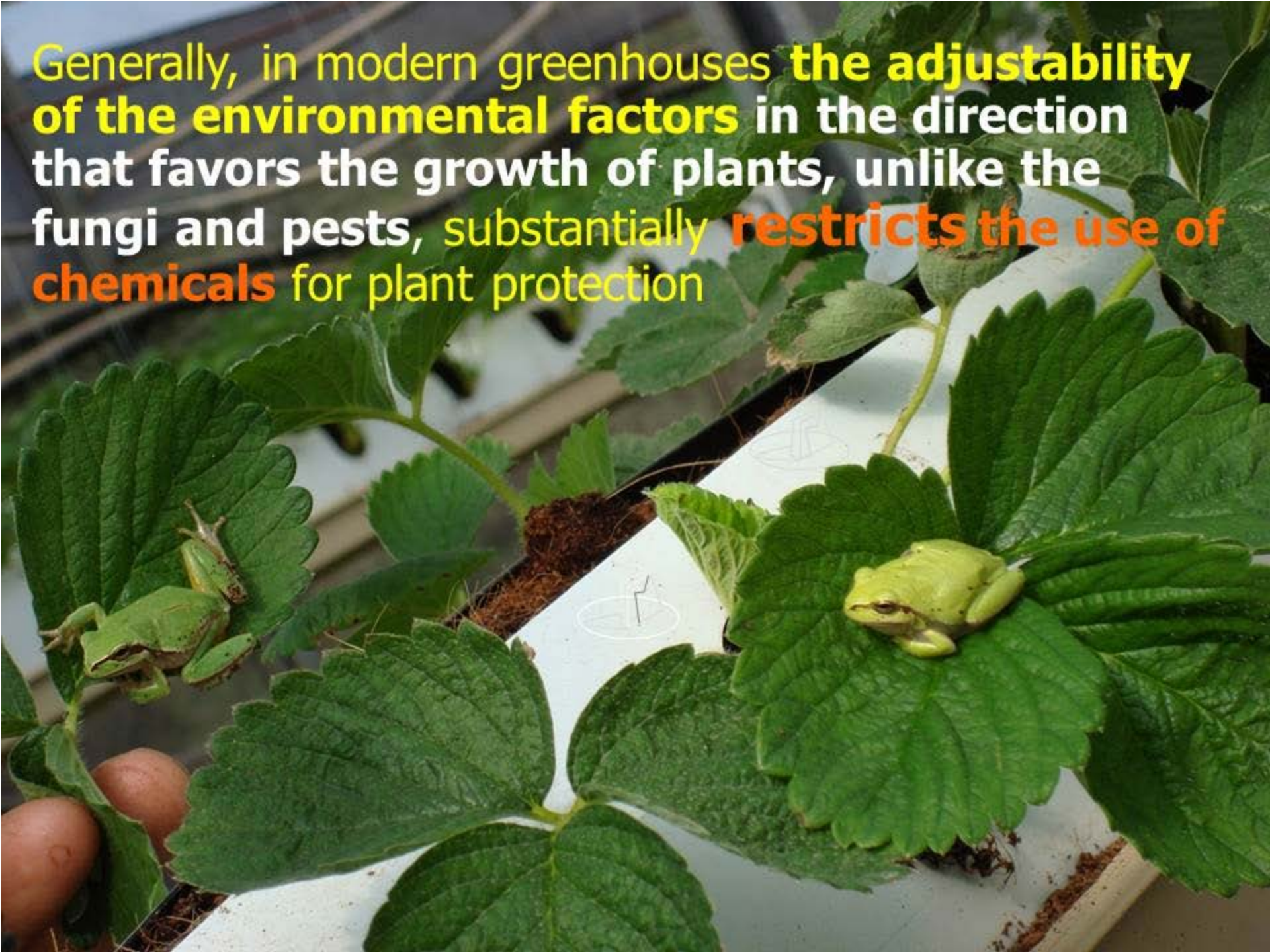


2. Technologically sophisticated Greenhouses



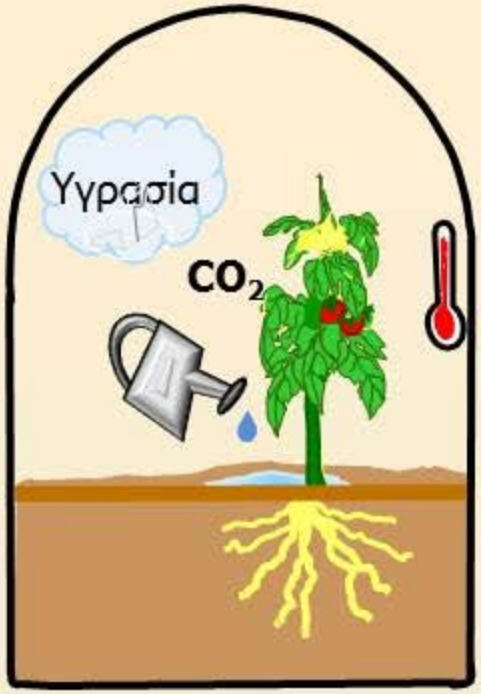
The exact **control of environmental factors, offers** more in:

- ✓ **the ability to schedule the production time**
- ✓ **maximize production**
- ✓ **improving the quality**
- ✓ **use of fewer or not at all chemicals for plant protection**

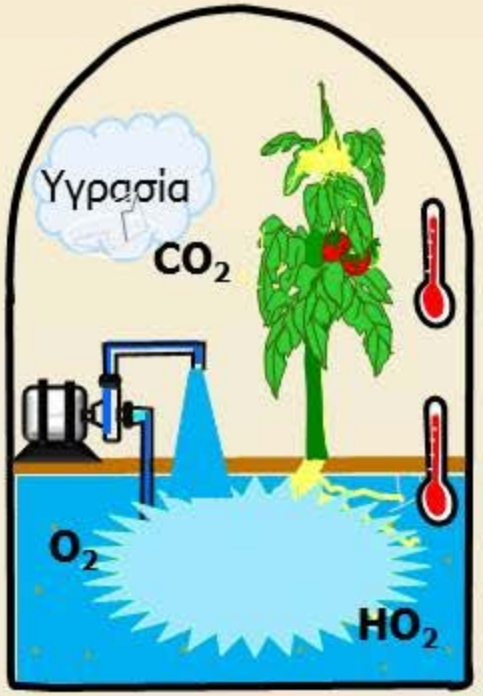

Generally, in modern greenhouses the adjustability of the environmental factors in the direction that favors the growth of plants, unlike the fungi and pests, substantially restricts the use of chemicals for plant protection


Hydroponics !
what offers plus ?

With the modern greenhouse facilities, achieve the control of environmental factors of the crown of plants to desired levels



With hydroponic facilities, achieve the control of environmental factors of the root of plants to desired levels




In Hydroponic Greenhouse the plants are
NOT grown in the soil

Various methods are used in hydroponics for plants cultivation:

- **Growth in inorganic, inert, porous substrates,** in which is added nutrient solution

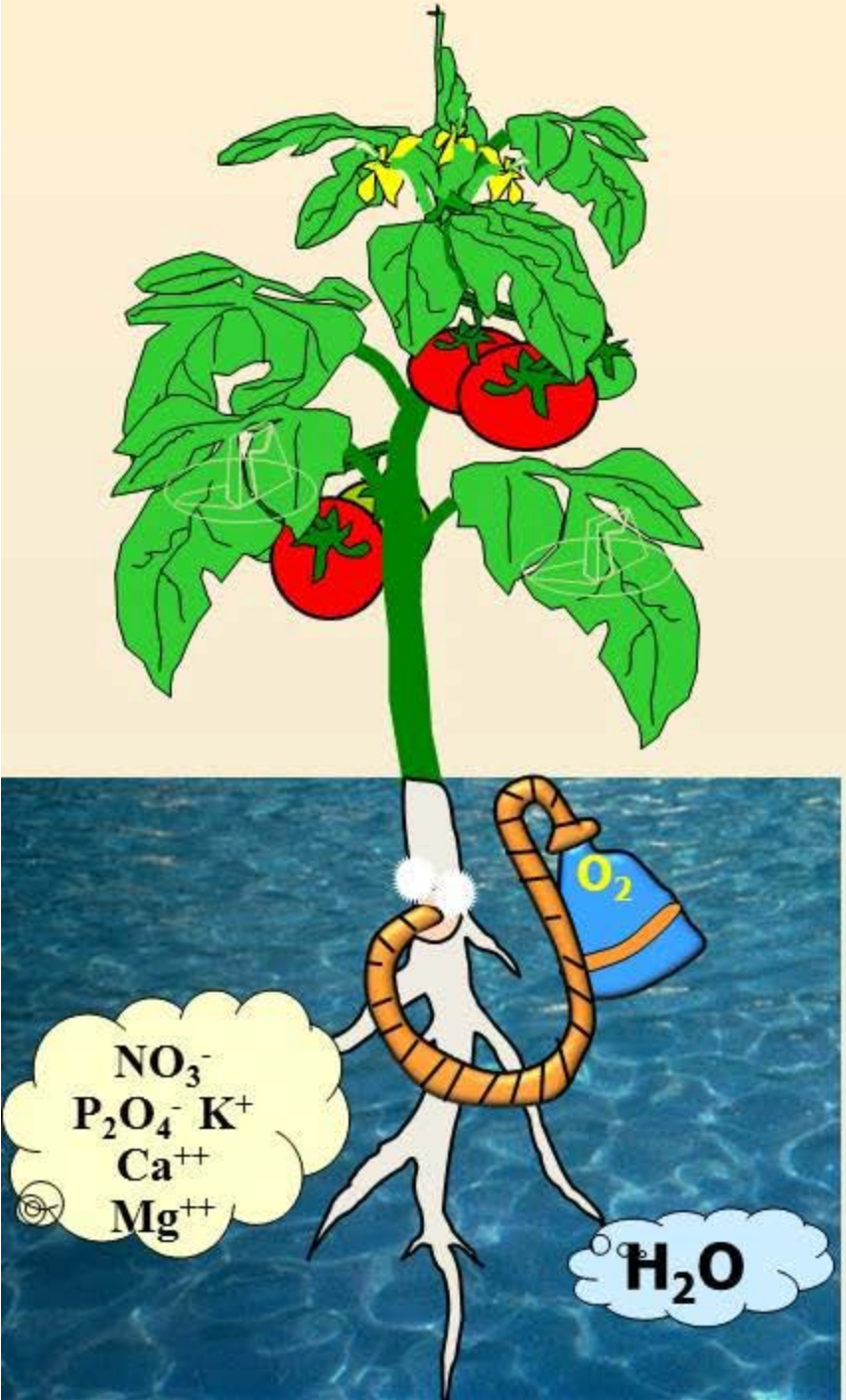
- **Growth in organic porous substrates** on which nutrient solution is added (e.g. bark trees)

- Growth only in nutrient solution

In general, in hydroponic systems **the roots are bathed periodically or continuously by a moving nutrient solution** which contains the necessary elements needed for plant growth.

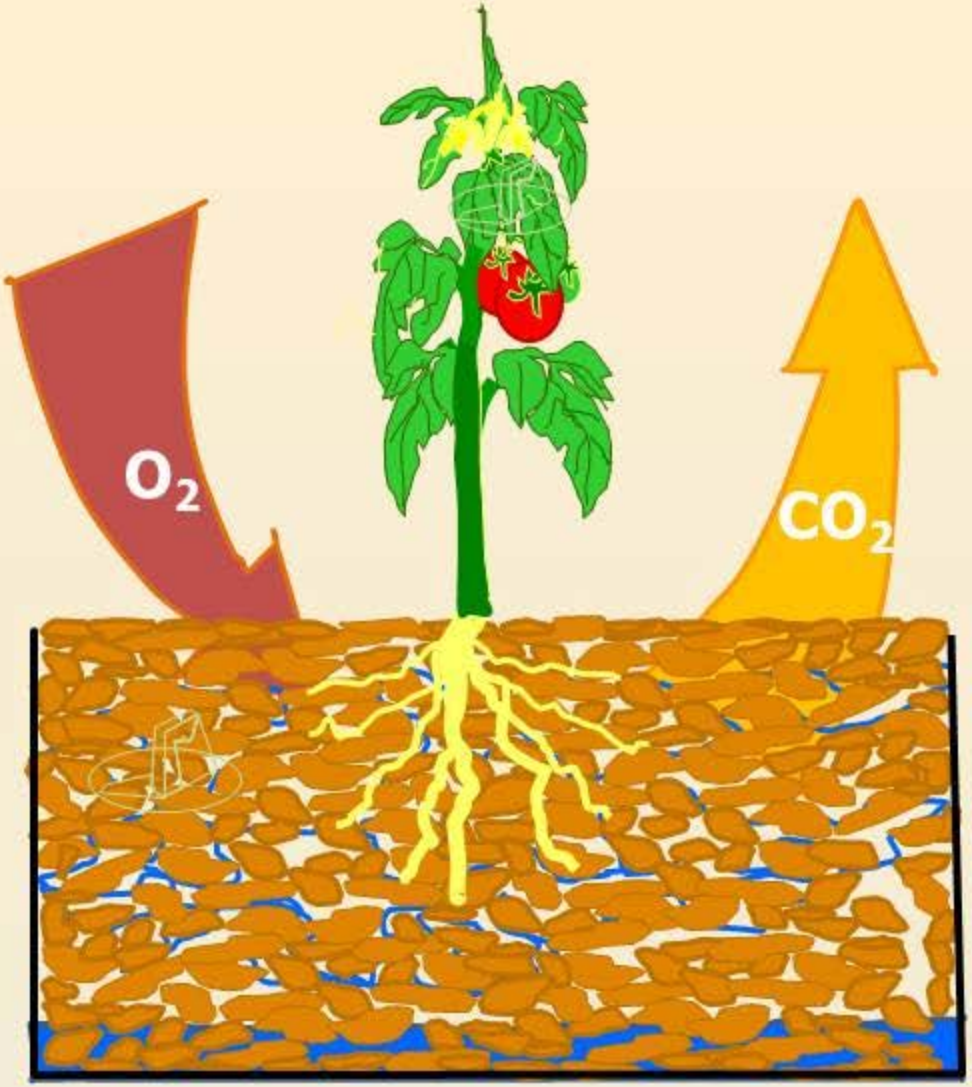
It can be assumed that **the whole surface of the root comes in contact with whole nutrient solution**

Why the control of root environmental factors can't be done in the soil ?



Generally, for the proper development of plants is essential in their root to exist:

- **Plenty of oxygen** and simultaneously
- **Plenty of water** that has dissolved the necessary
- **inorganic nutrient elements** in their proper proportion.



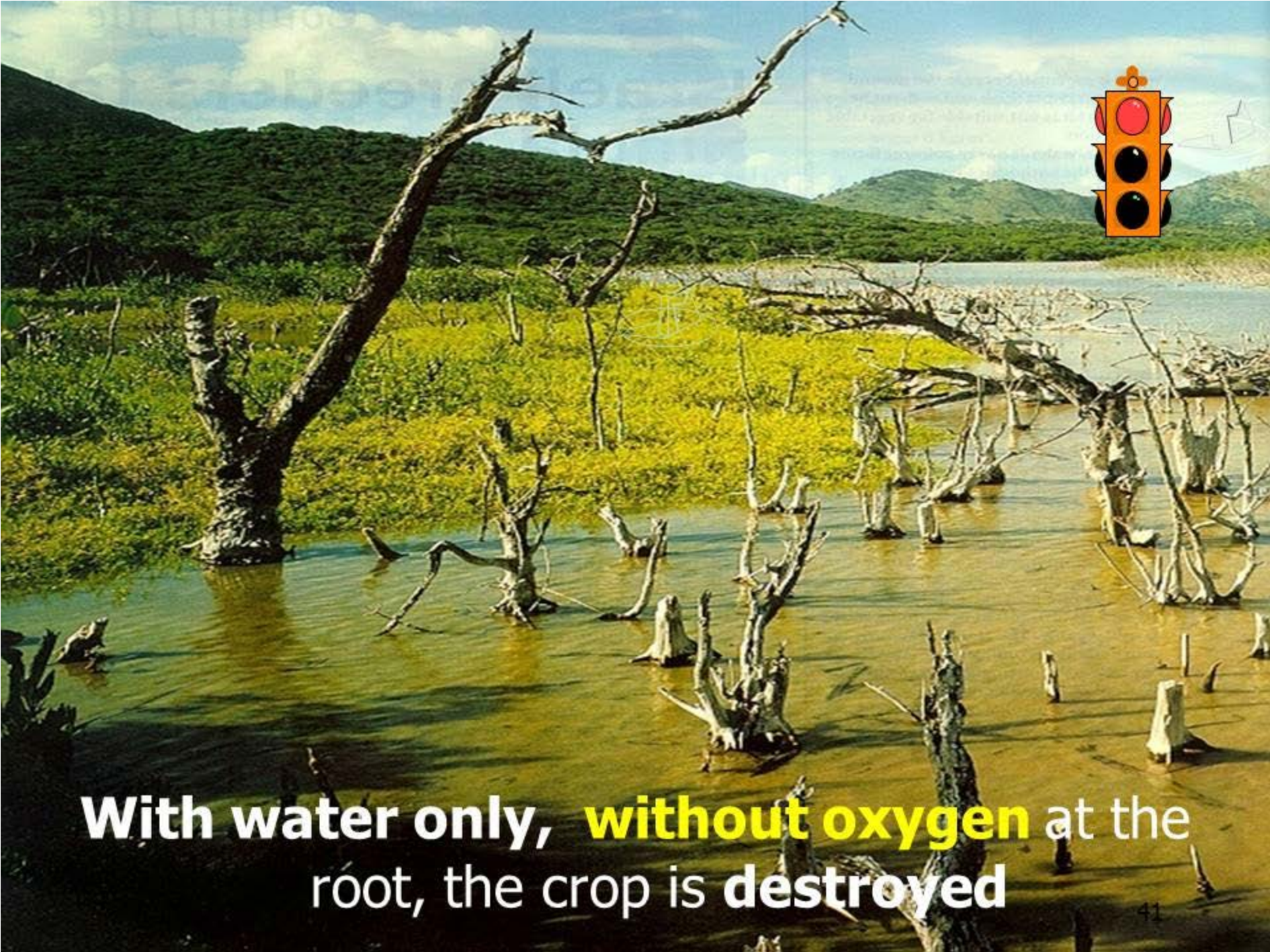
Gas exchange in soil and substrates

In conventional soil cultivation is difficult to achieve the best balance for water and oxygen.

In soils, in most cases**, the more water** there is **so less oxygen stays and contrary**,

thus some time **the water and** some time **the oxygen is in lack of.**

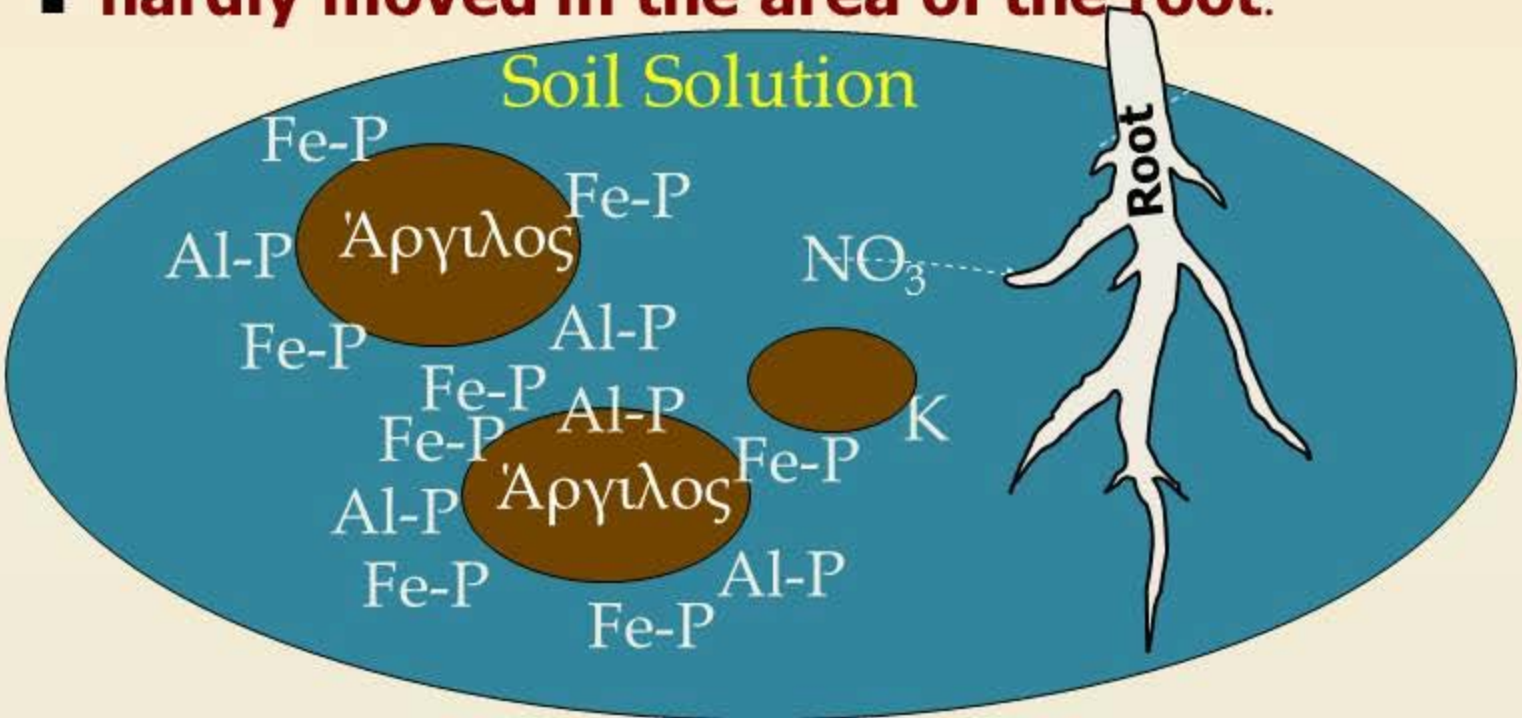

With oxygen only, without water round the root, the crop is destroyed


With water only, without oxygen at the root, the crop is destroyed

For the crops grown in soil it is **important**, also, the problem of **the availability of inorganic nutrients** near the root.

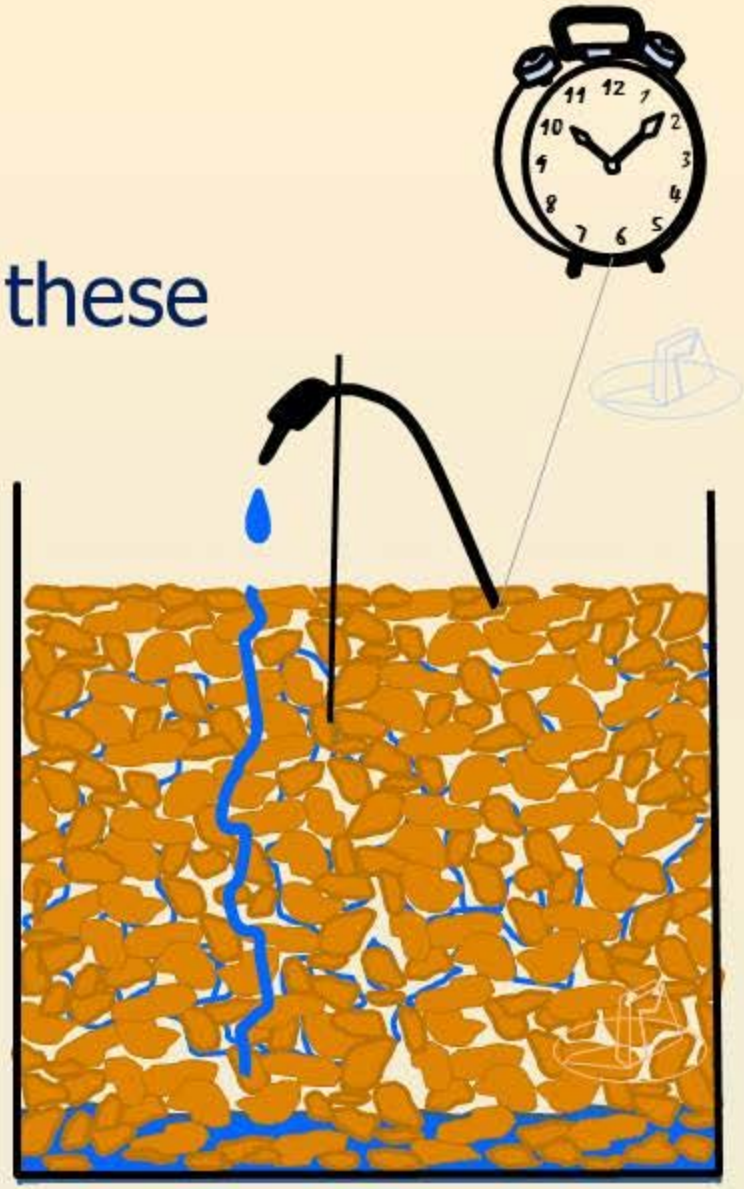
It can be added mineral nutrients in the soil, but these are not always immediately available to the roots, because:

- **bound to the ingredients of the soil** or
- **hardly moved in the area of the root**.



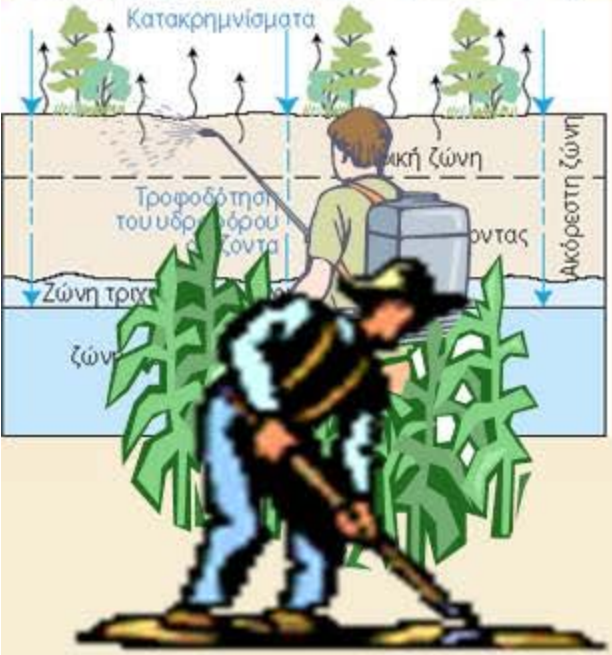
With hydroponic systems these problems **are solved:**

- **with the use of materials having high drainage and chemically inert** (in cases where used solid substrate)
- Because the system provides the ability for a **better control of irrigation**



Other advantages of hydroponics ?

With hydroponics can produced agricultural products in areas without any soil or in areas with poor soil or even on the roof of a House



- **the creation of a pleasant working environment for the employee**
- **water & nutrients saving**
- **prevention of groundwater pollution**
- **exemption from soil diseases**

- **the limitation of the hard manual work** (cultivation of the soil)
- **simplification of the program of work,** (lack of herbicides etc.).

Disadvantages ?

- It is a **more complex system** for agricultural production and therefore **required more knowledge** than are needed for soil cultivation.

- **It isn't showing** great **tolerance on errors**.

- But **with awareness** and consistent application of appropriate techniques, **can be expected a good reward**

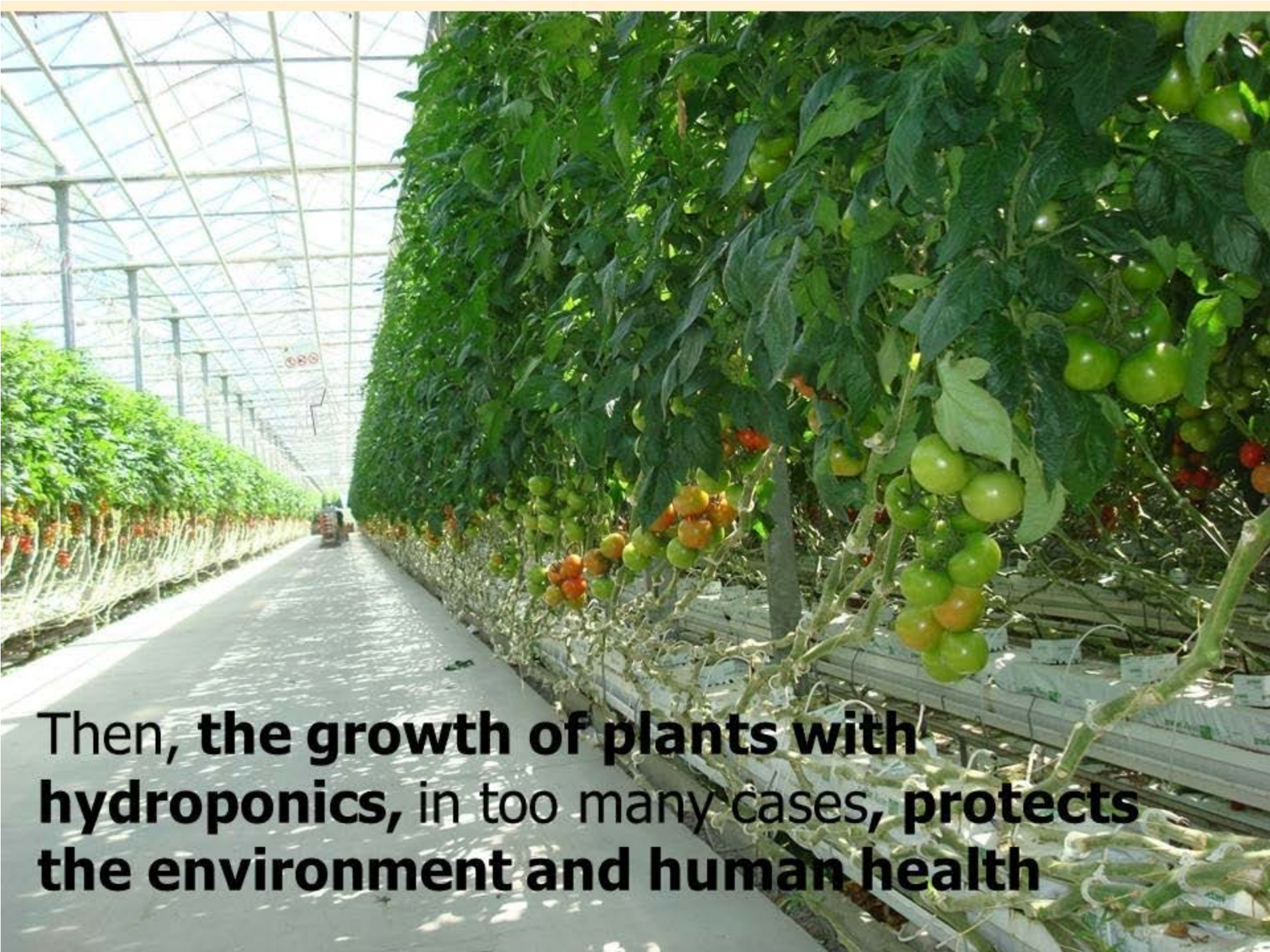
Creates the hydroponics problems in the natural environment ?

At first glance, food production by hydroponics is evaluated negatively, **because it is a process that produces food out of the natural environment**.

But **if you take into consideration** that **the world's population is expected to increase dramatically by 2050, while the cultivated area on the planet cannot increased**

And that the man with the **intensive cultivation**

- **destroys the soil**
- **Uses large amounts of chemicals for the soil** disinfestation, which they pass to the food, **to the detriment of consumer health**
- **destroys vast tracts of forests**


Then, **the growth of plants with hydroponics,** in too many cases, **protects the environment and human health**

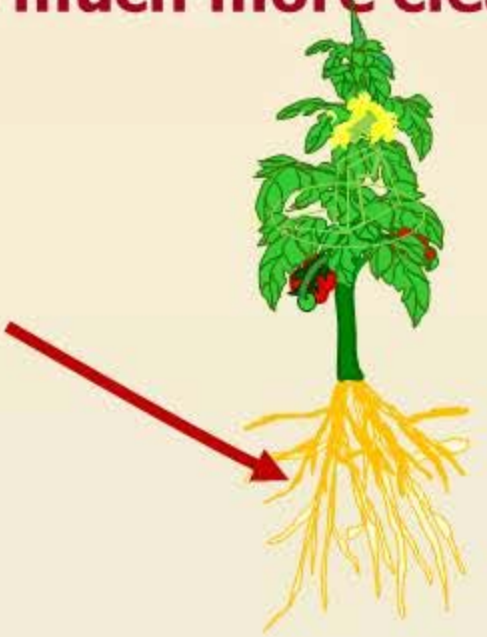
The biological value of the hydroponic products ?

The view that in **hydroponics the plants grow in inorganic chemical solutions** and therefore have lower nutritional value **is simplistic,** because**:**

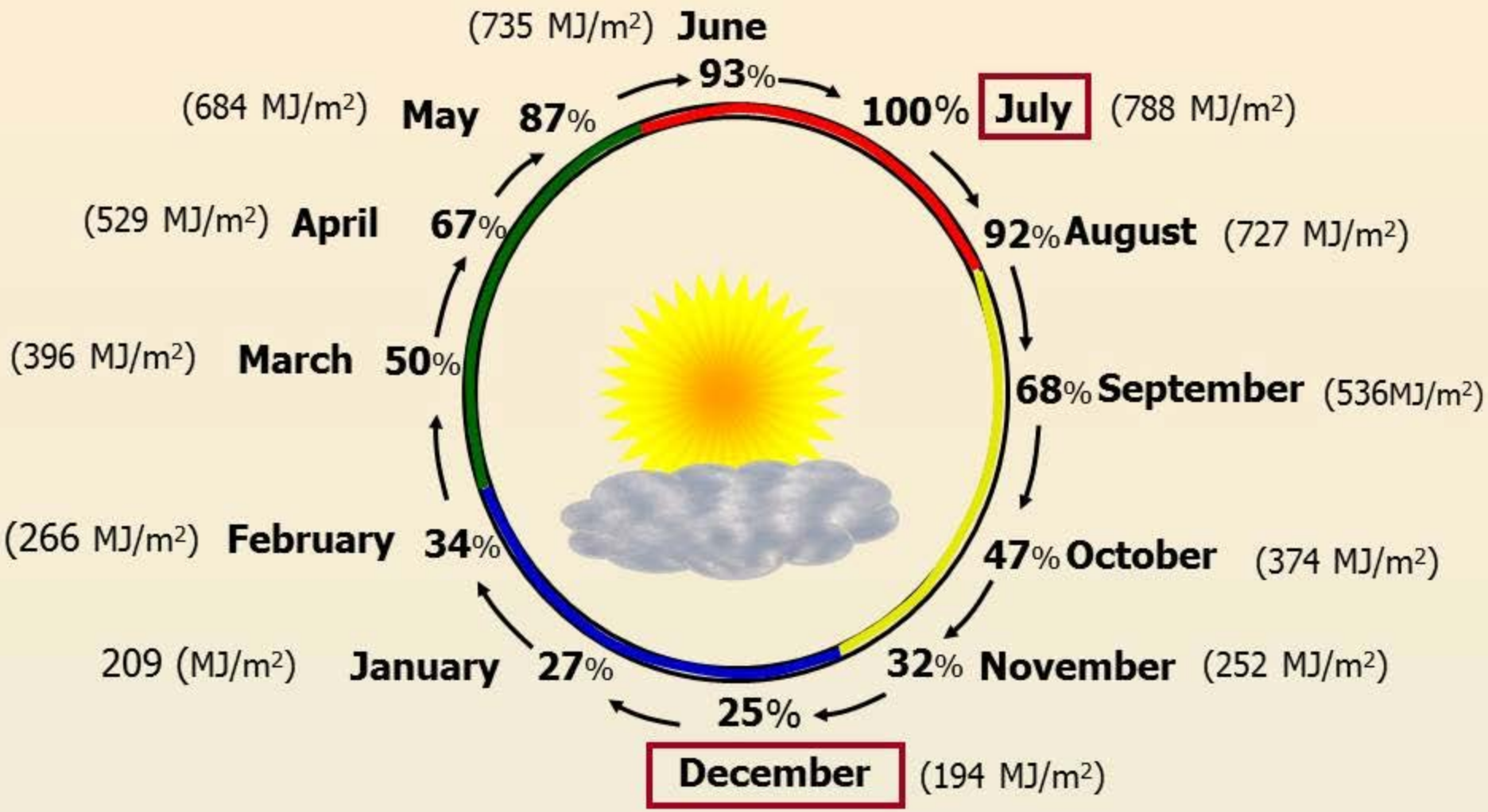
not only in hydroponics but also **in the soil cultivation** (with the exception of organic farming), the **plants are grown with the use of chemical fertilizers**

The fertilizers used in **hydroponics are much more clean and free of heavy metals**.

As in **the case of soil** so and **in the case of hydroponics**, the **root is the entry control filter** of the different chemical elements going to the plant organs.



However **the quality of the products vary at different locations and different seasons**, because it depends greatly on the size of photosynthesis



The change of incident solar radiation with time, in Athens

Research proves that hydroponic products:

- **do not differ in taste and aroma** than those grown in the usual manner on the soil, even
- **contain minerals and vitamins** just in the same quantity with high quality soil products.

Hydroponic growing can be done by several methods


Growing in bales of straw


Growing in organic substrate

Growing in substrate mixture of organic and perlite

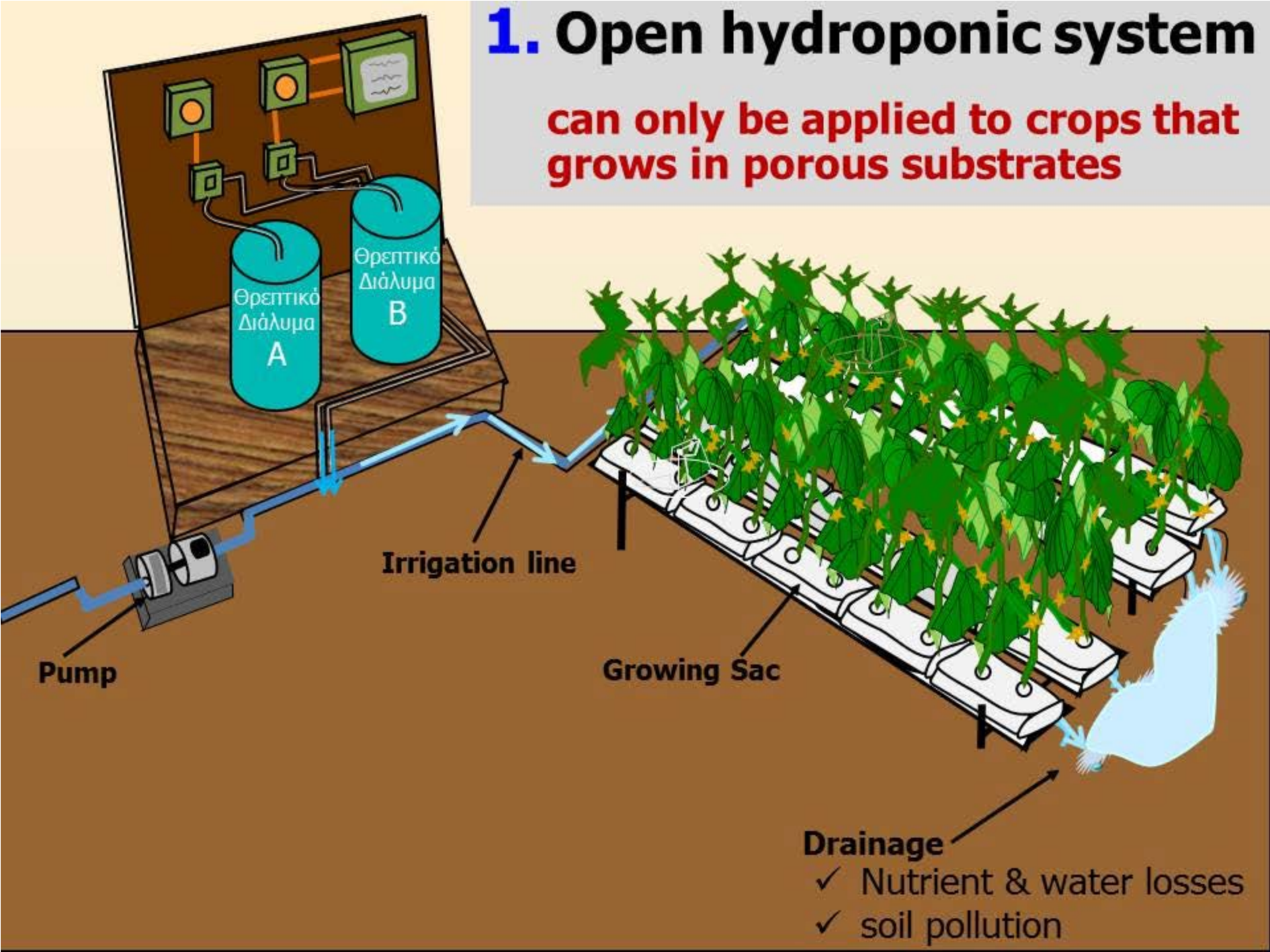
Growing in expanded clay pellets


Tomato cultivation in perlite substrate
The white plastic sheet isolates the ground, for protection against soil contamination and weed growth

In hydroponics, the mainly used distribution systems for nutrient solution are two

1. Open hydroponic system

can only be applied to crops that grows in porous substrates



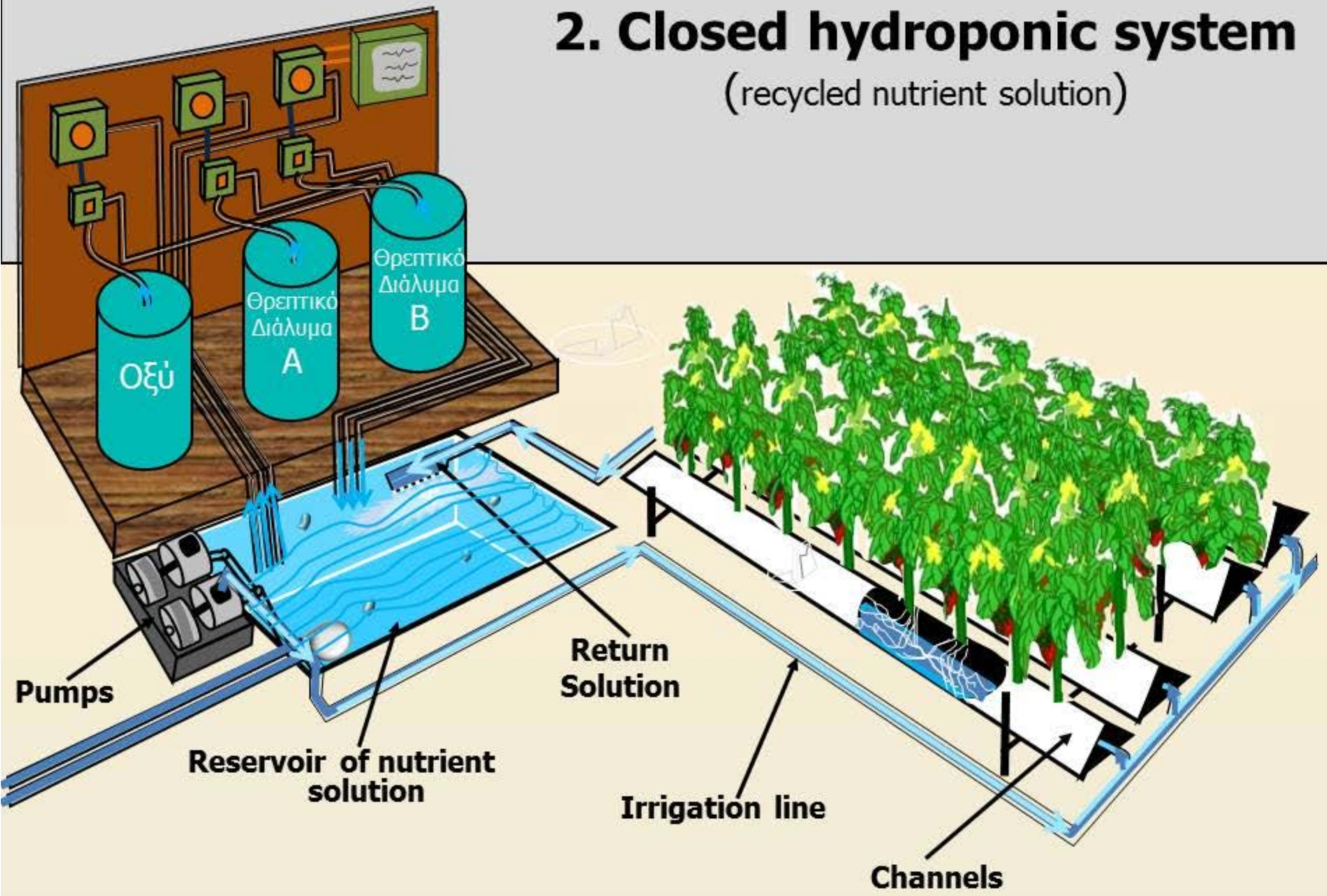
Open system, tomatoes grown on Rockwool

Open system, Cucumber grown on Rockwool


The collection of drainage solution protects against environmental pollution.
The solution can be used for fertilizing outdoor crops

2. Closed hydroponic system

(recycled nutrient solution)



Closed hydroponic system

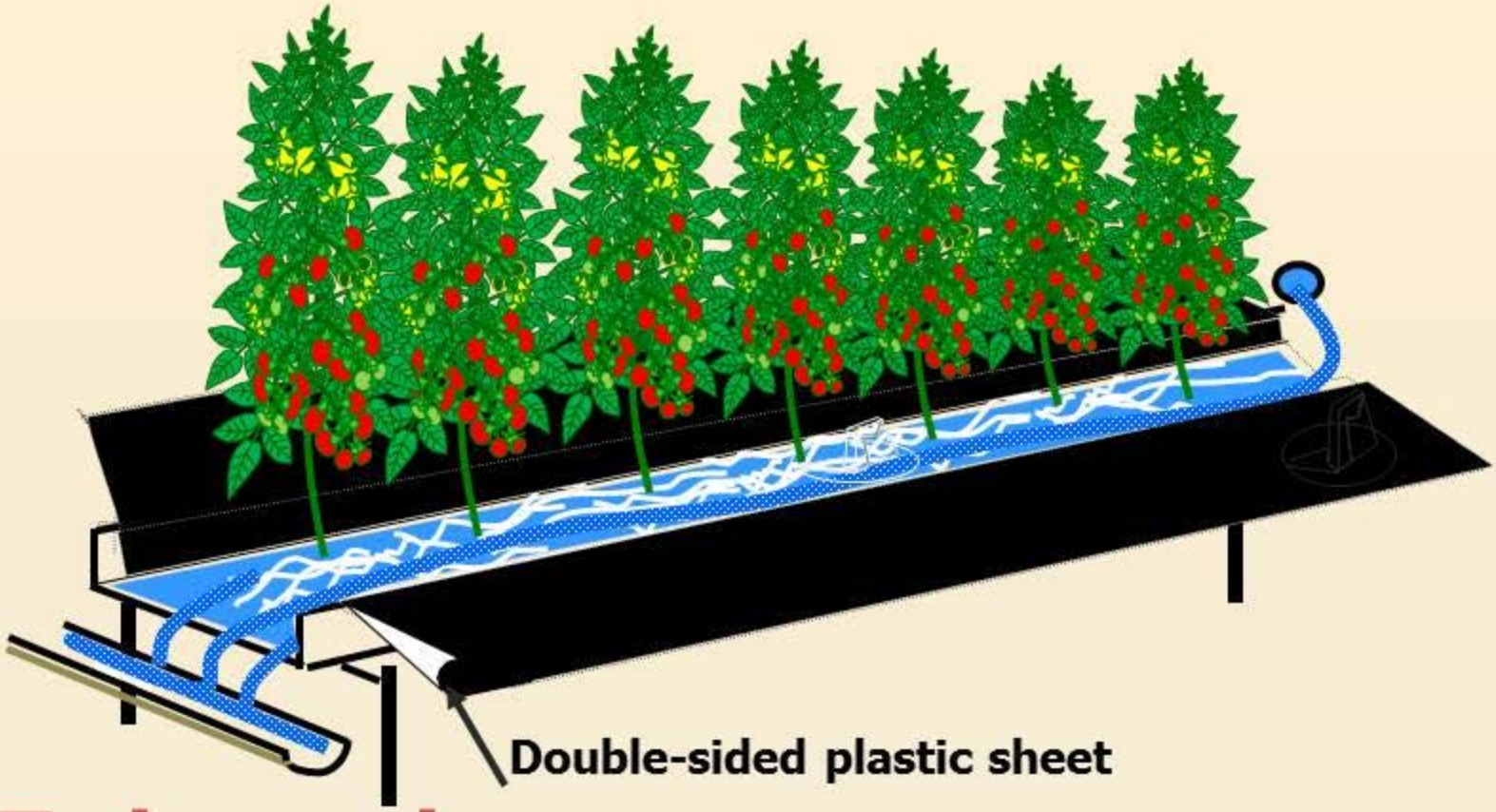

Closed hydroponic system in Rockwool

Closed hydroponic system, in vertical growing strawberries


Closed hydroponic system in growing
Strawberry on two levels

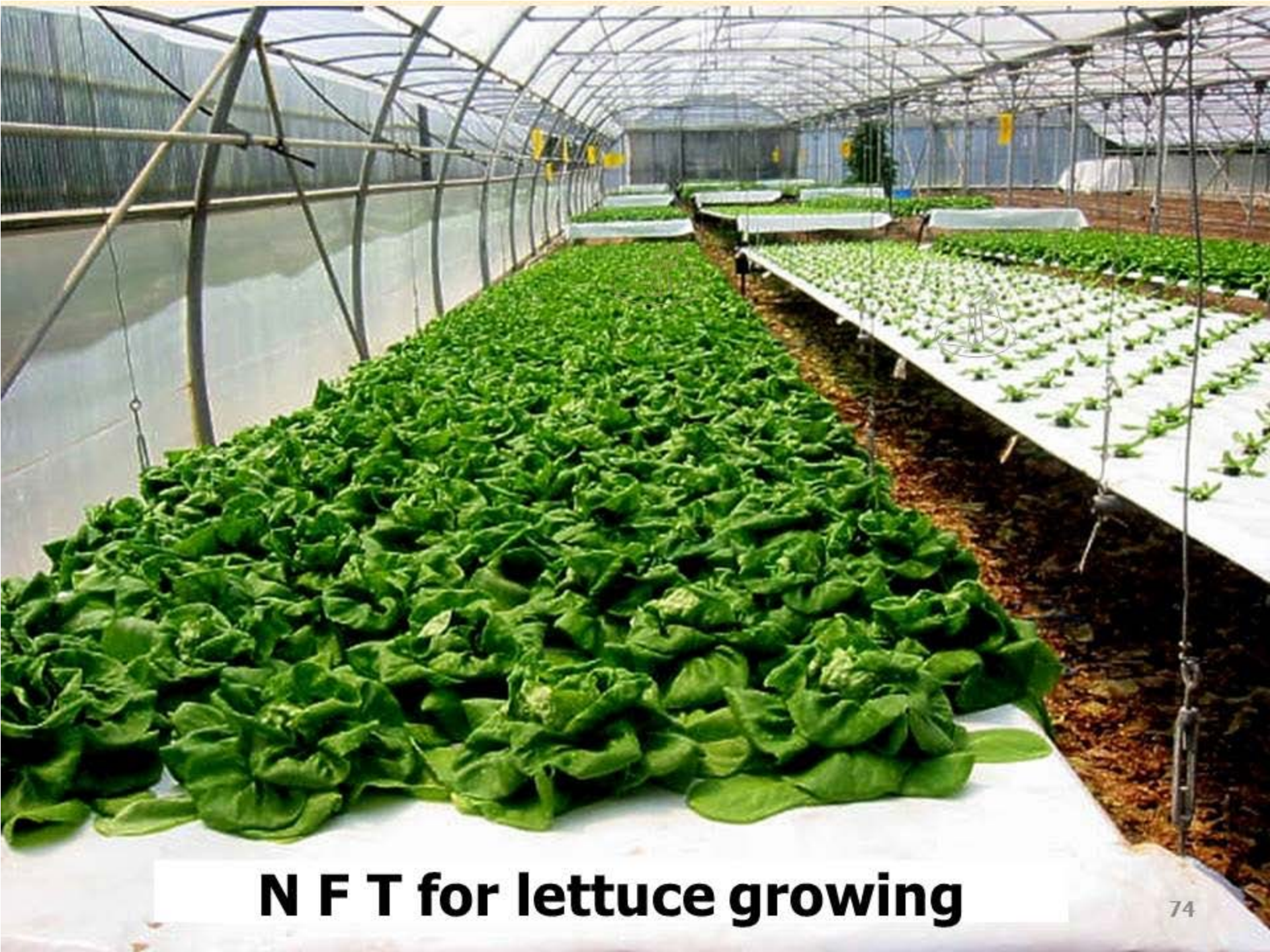
Closed hydroponic system, NFT. Plants grown in thin layer of nutrient solution


Closed hydroponic system, N.F.T.
(without porous substrate)



NFT channel

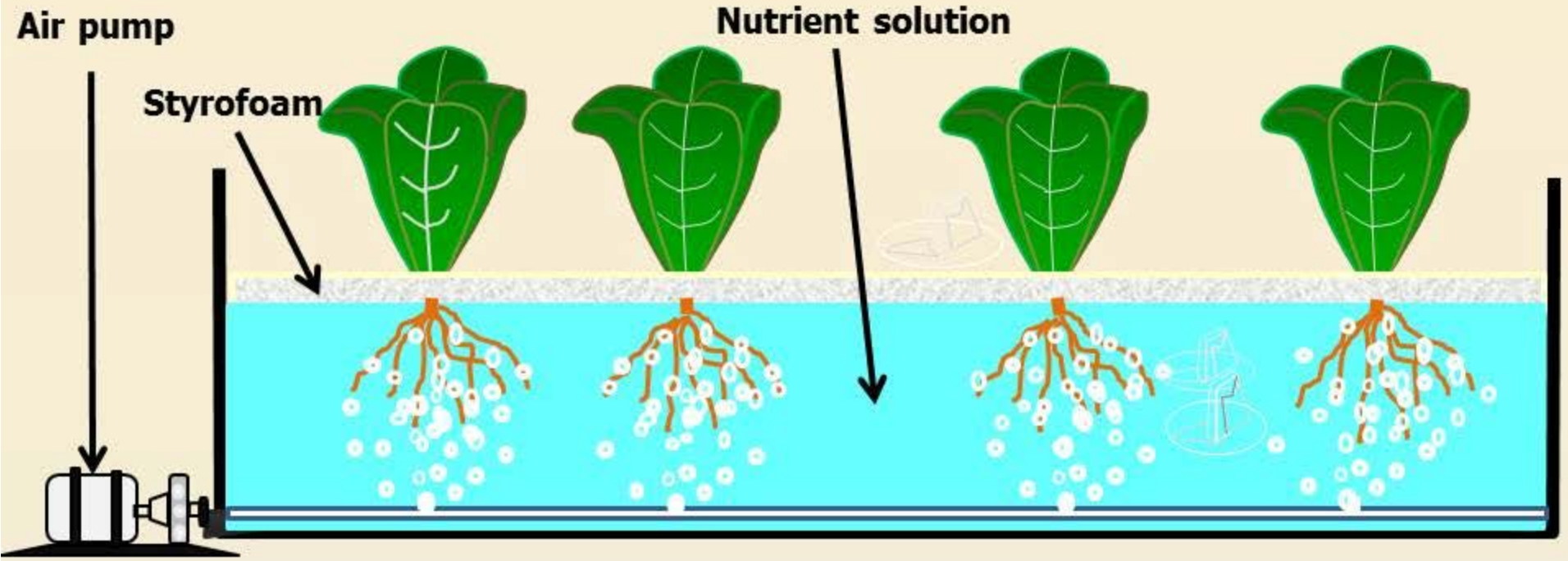
The nutrient solution is fed at the highest point of the channel, with gravity ends up at the lowest point, whence with pipes driven into the tank of nutrient solution



N F T for lettuce growing

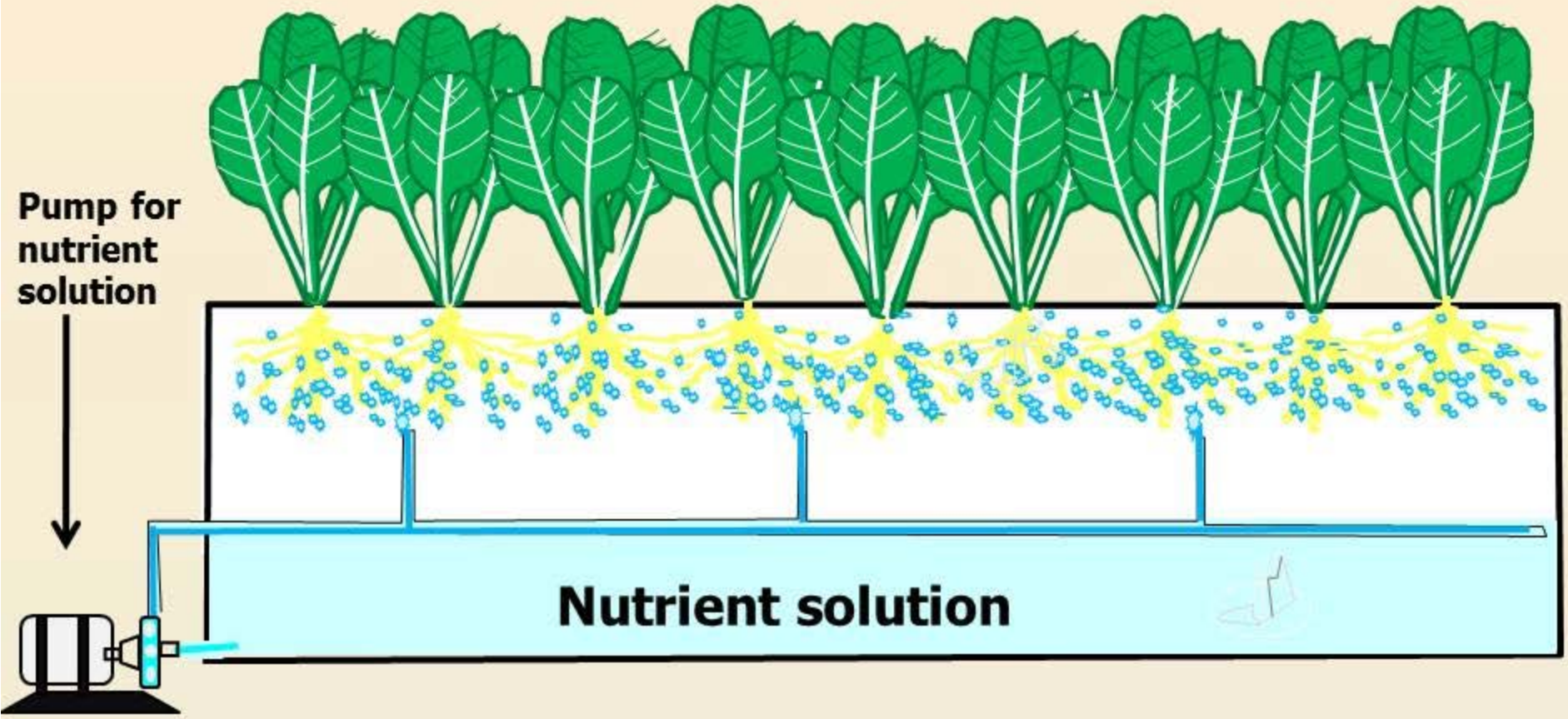

NDT hydroponic growing method

Growing in basins



The nutrient solution is supplied with ambient air (oxygen enrichment)

Aeroponics



In aeroponics **plant roots are soaked with nutrient solution by spraying**.

This ensures plenty of oxygen, along with water and nutrients

As better quality water available, so higher production is expected

The quality of rainwater is the better one

What you should keep in mind to choose a greenhouse installation?

When choosing a commercial greenhouse, should be assessed and balanced information relating to:

1. **economy**
2. **biology** and
3. **technology**

In order to have an economically beneficial enterprise, the greenhouse installation should be:

- ✓**suitable for the products** that we intent to produce and
- ✓**can easily be used and maintained**

Some economic factors taken into consideration in choosing a greenhouse installation are:

- **available capital**,
- **interest rates** banks lend,
- possible **subsidy**
- **prices of the products** in the internal and international market.

All of these greatly **affect the choice of:**

- greenhouse **type,**
- greenhouse **size** and
- Proper **equipment**

For all the plants the same Greenhouse ?

The requirements of agricultural plants to the environmental factors **vary in different plant species.**

In General, **plants** grown in commercial greenhouses **can be grouped into three categories**:

А. leafy ornamentals

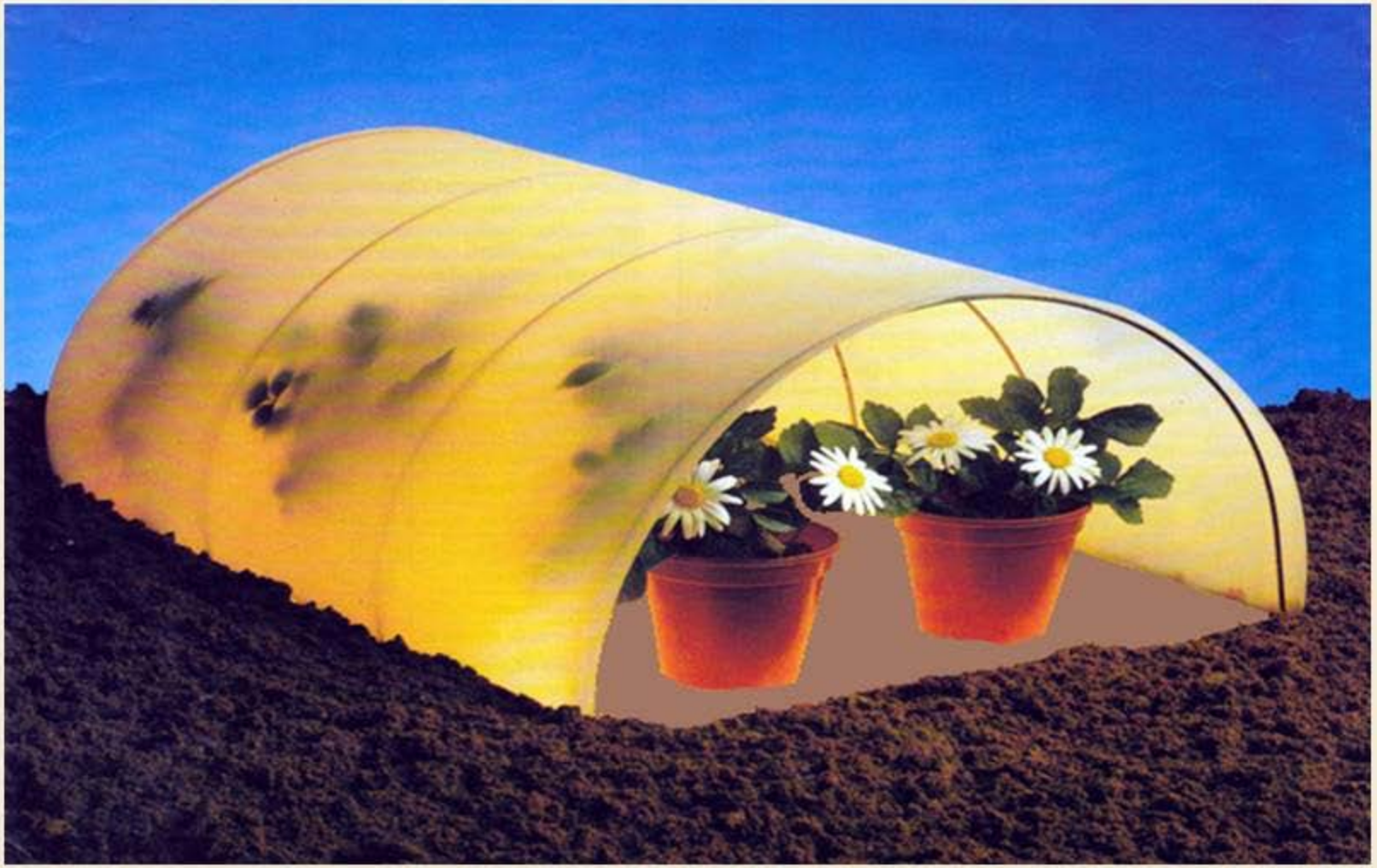
Б. pot plants blooming

Г. Vegetables & cut flowers

1. **Leafy pot Ornamentals**, whose growth is stimulated **under conditions:**
   - **on low light and**
   - **high relative humidity,**

2. **Pot plants sold blooming** whose growth is stimulated **under:**

average lighting and humidity conditions



3. Most **vegetables** and ornamentals for **cut flowers**, favored by:

- **very good lighting** and
- in **medium** values of **relative humidity**

Therefore **each of these three major categories of plants need a special greenhouse installation,** which can offer different requirements on the environment in each case.

The difference may relate to:

- Mostly on **greenhouse equipment** and
- the **construction** it self

1. The leafy pot ornamentals fit to a greenhouse :

- rather watertight, to **maintain high humidity**
- **There isn't** particularly **interest in great permeability to the light**
- **There isn't** particularly **interested in the existence of large-scale windows.** Because the restriction on the entry of solar radiation with mandatory shading during summer, **creates smaller needs for ventilation**.

2. The pot plants sold blooming require a greenhouse:

- **to offer as much light as possible during winter** time**,** while
- **To lends itself to easy shading during the summer,** in order to avoid high light intensities.

3. Vegetables and Cut flowers require a greenhouse with:

- **maximum permeability to the light, Autumn, winter and spring**, and
- with a very **efficient cooling and ventilation system**, especially in the summer.

Equipment of a modern greenhouse for vegetables and cut flowers production ?

Lighting

The more light during winter, inside the greenhouse, the higher production is expected

Wash devices to increase the sun light inside the greenhouse

Artificial lighting increases the production and improves quality during winter

Artificial lighting with LED save energy

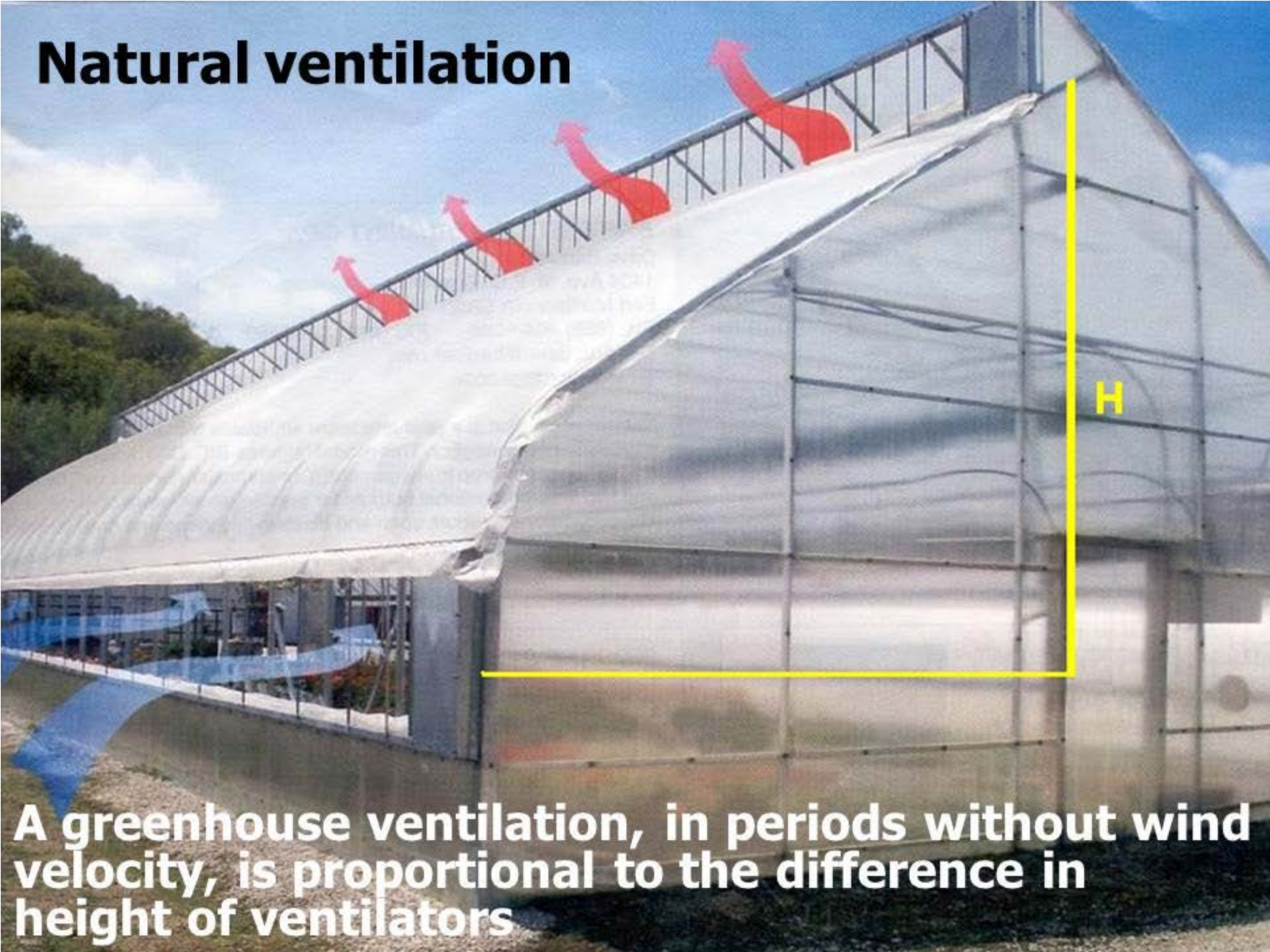

White curtains for shadow, for lowering the temperature during summer

Black curtain for the photoperiod adjustment

Temperature setting

Ventilation

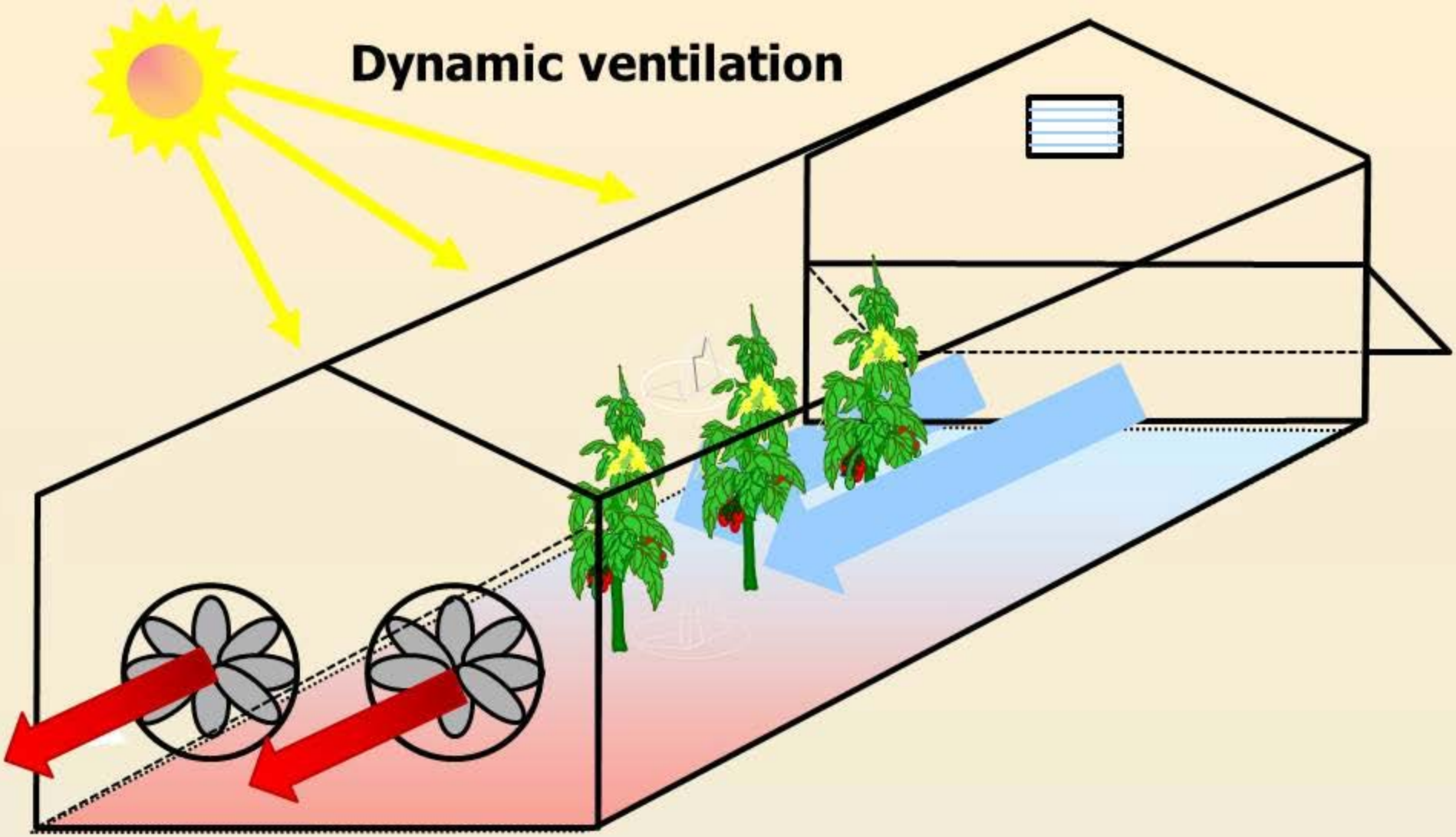

Every greenhouse, because it is covered with a transparent cover, accepts inside most of the incident solar energy
Therefore: on sunny days, the greenhouse temperature rises to very high levels


Natural ventilation
H
A greenhouse ventilation, in periods without wind velocity, is proportional to the difference in height of ventilators

Net on ventilators, protects from harmful insects

The dynamic ventilation consumes significant amounts of energy during the summer, but improves significantly the environment in areas with low wind velocity.

Dynamic ventilation

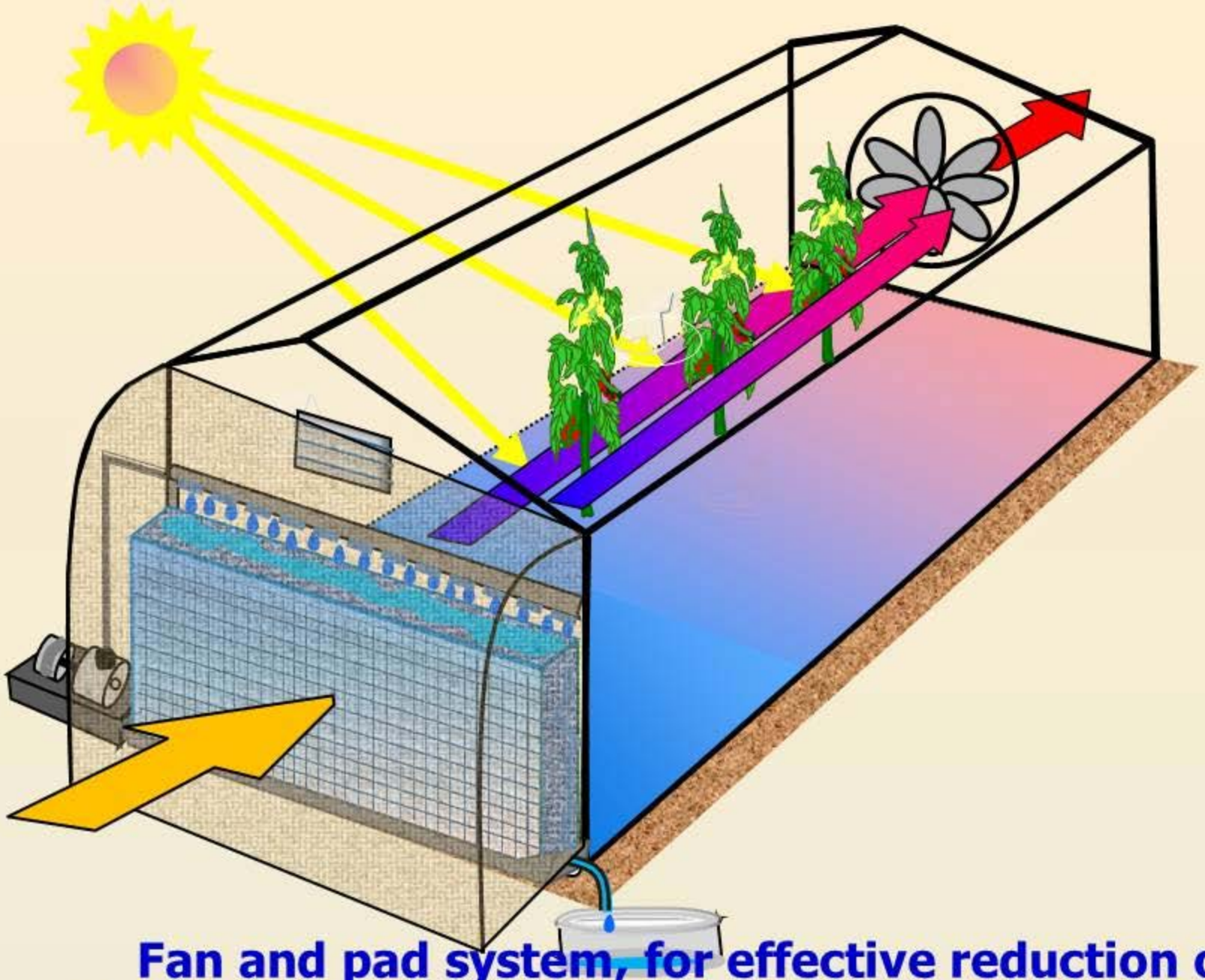


Fans sucks air from the greenhouse out.

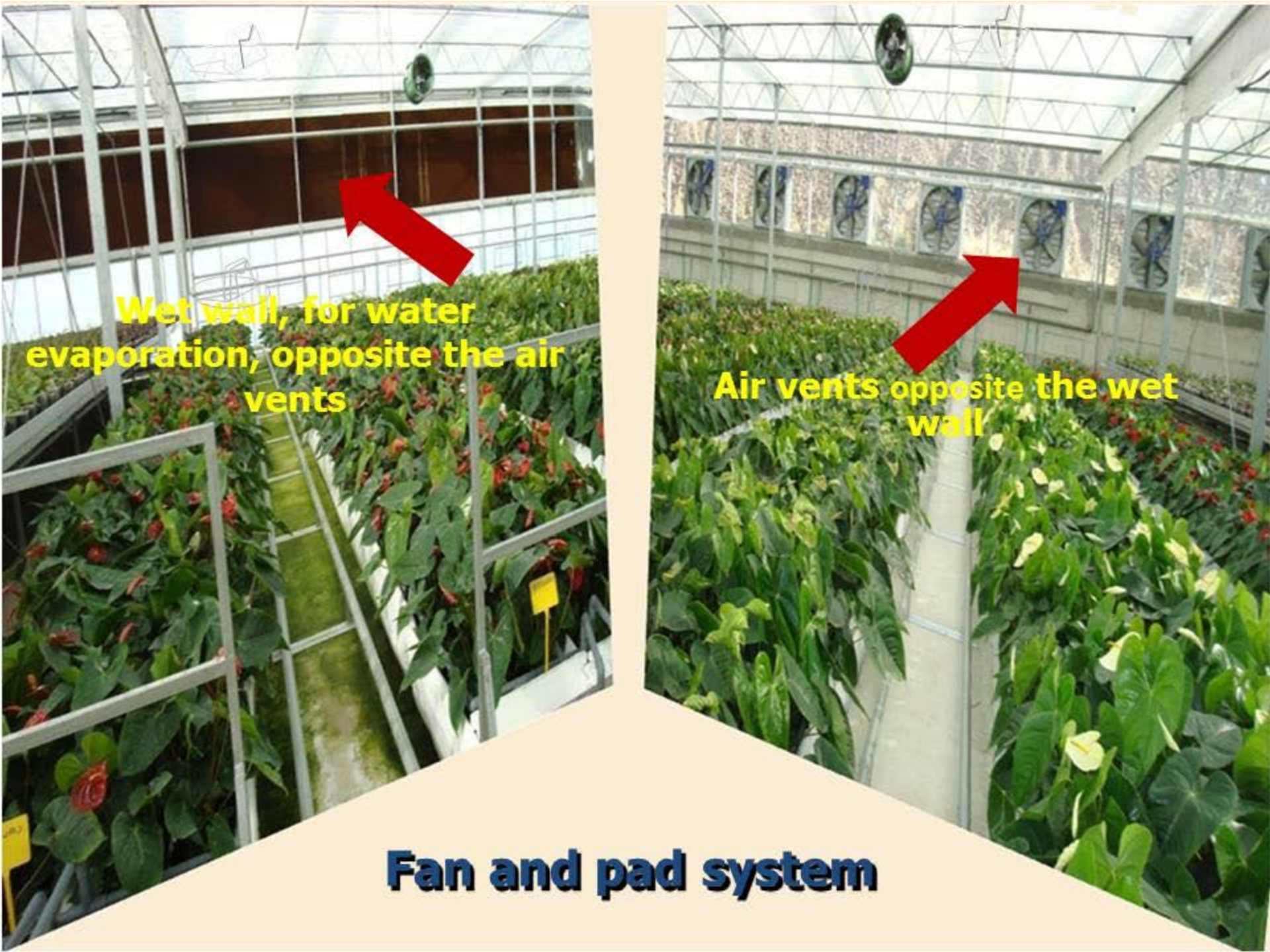
Outdoor air enters from the opposite side

Cooling systems

Fog system, for effective reduction of temperature in greenhouse without dynamic ventilation



Fan and pad system, for effective reduction of temperature in greenhouse with dynamic ventilation



Fan and pad system

Night temperature setting

Heating

Heating with hot water keep better the soil temperature

Heating pipes that serve as rail way

Electric trolley moving on heating pipes

Air heaters suitable greenhouse heating

Energy saving

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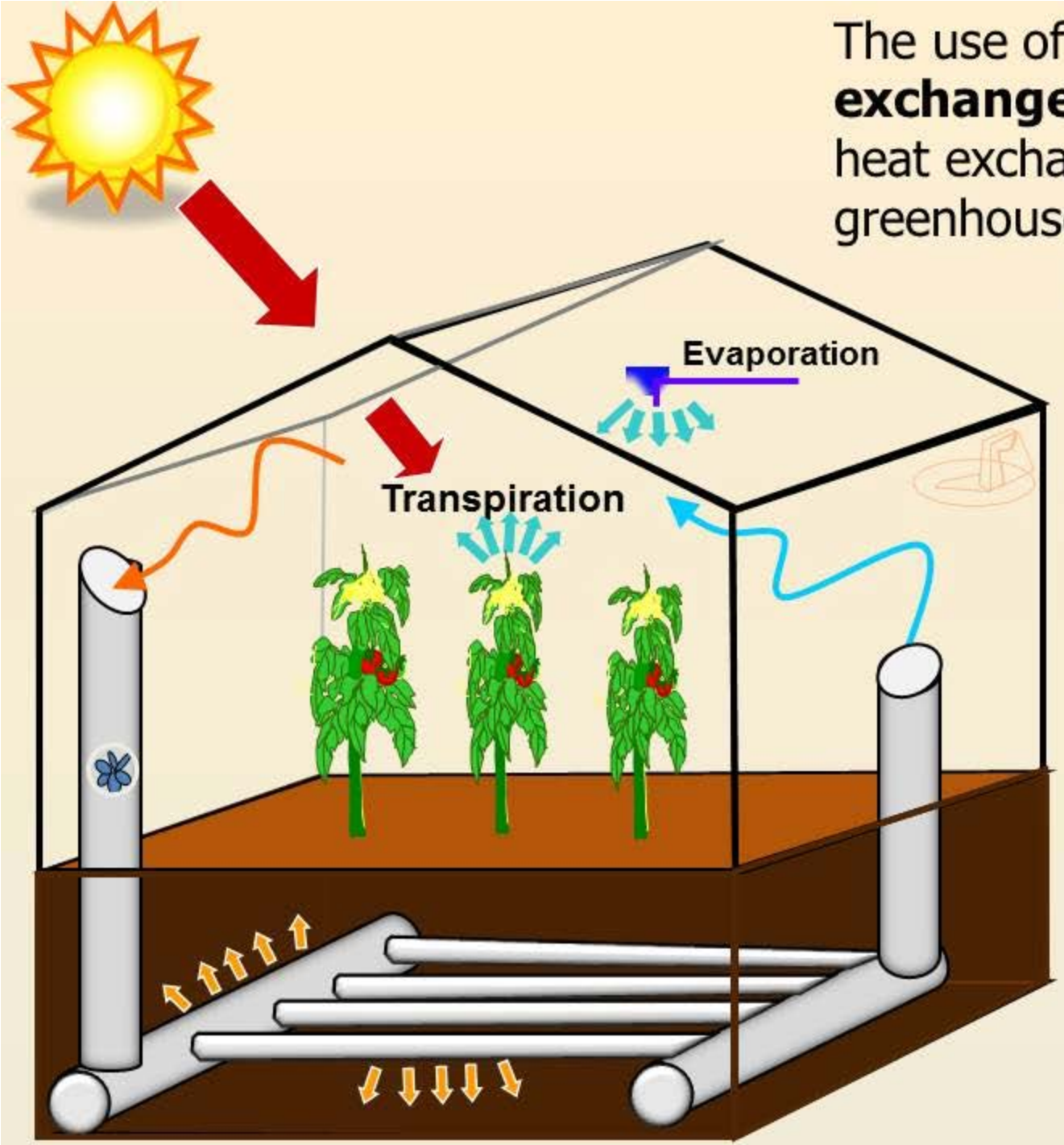
Renewable energies


Heat screen save energy during the night.
Is moved during the day by hand or by a timer or a photocell,
thus without any significant reduction in light during the day

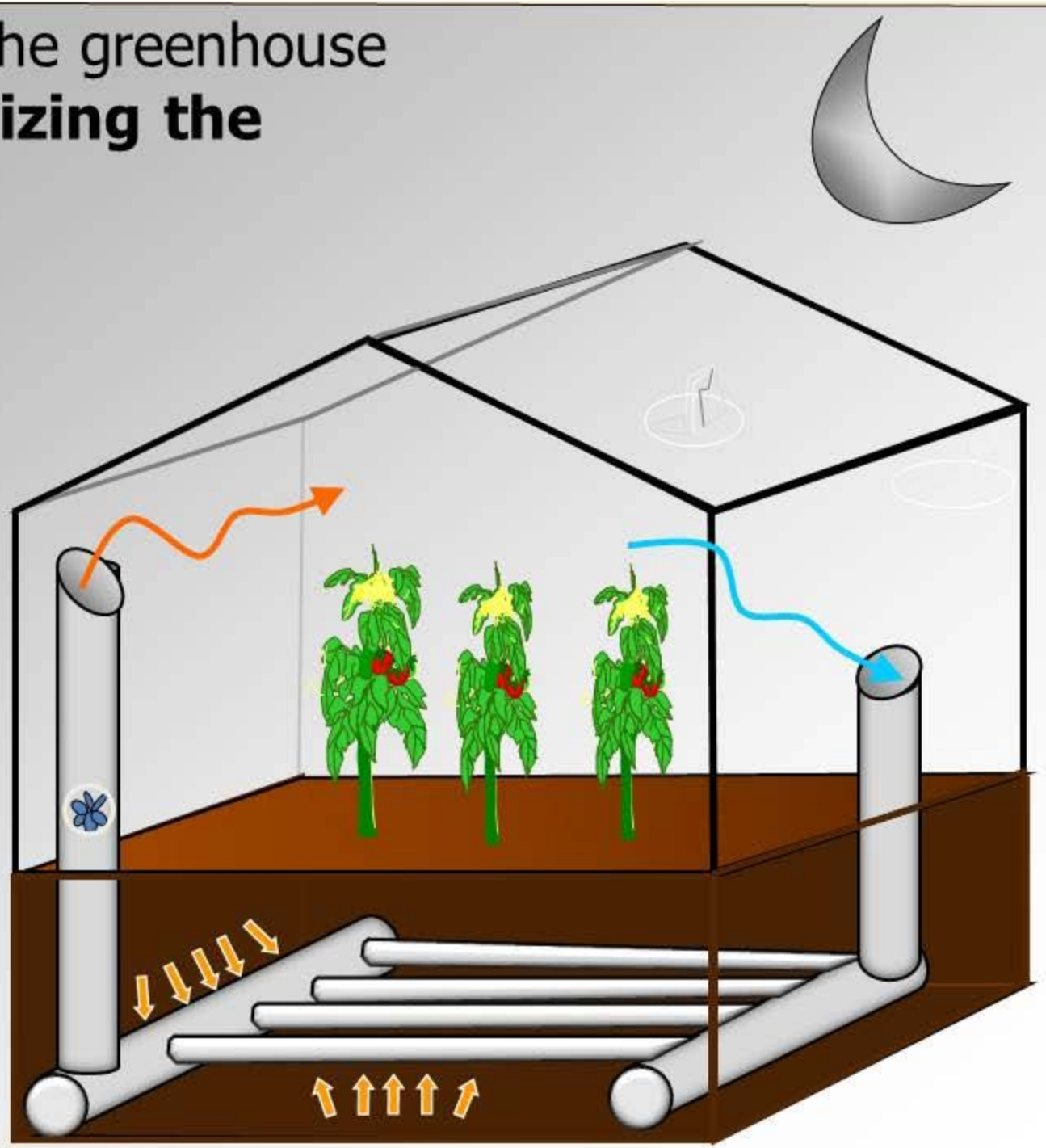
Solar collector, hot water industrial type, for greenhouse heating

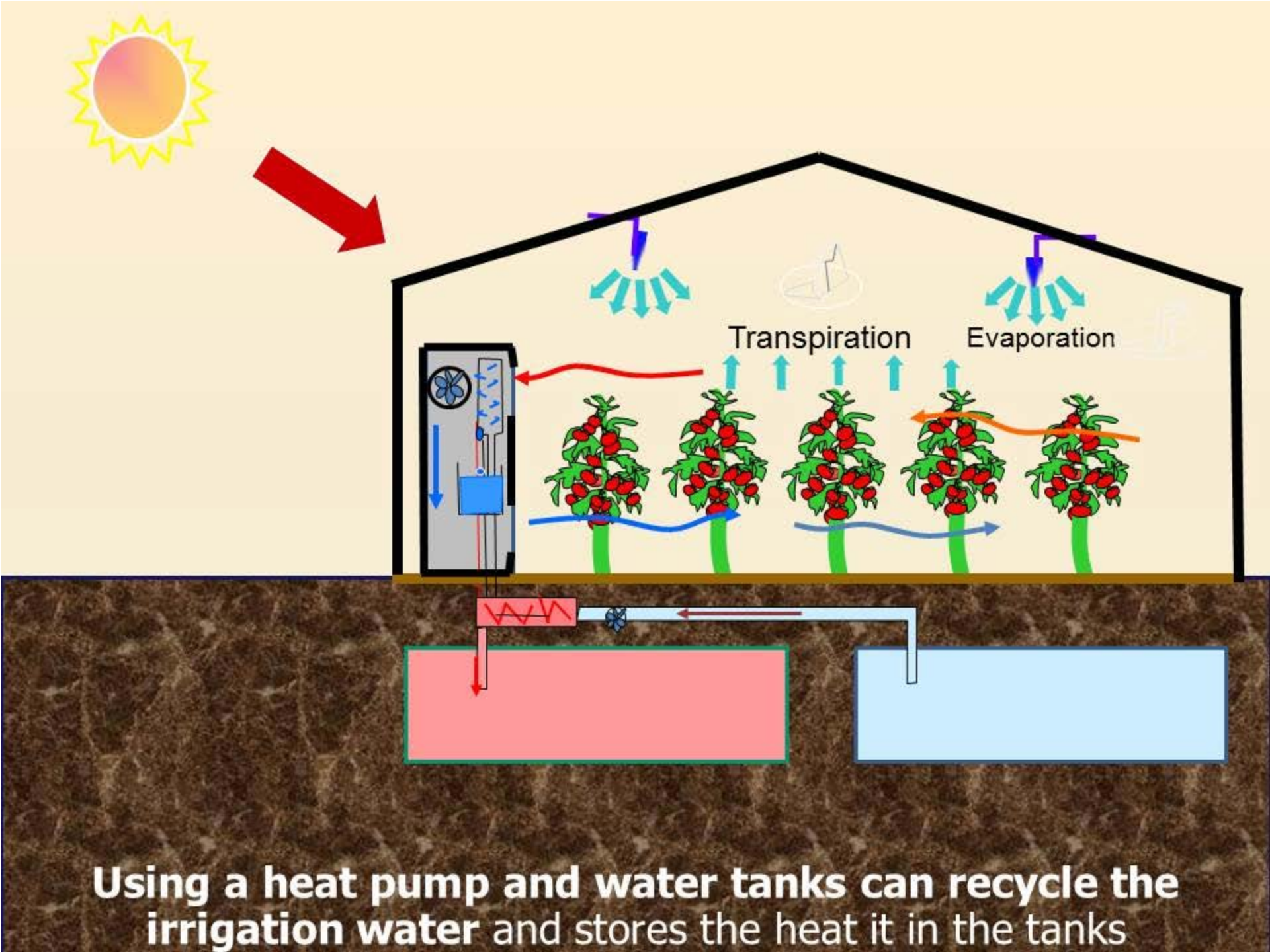
The use of an **earth-air heat exchanger** or **earth – water** heat exchanger could serve for greenhouse heating,

utilizing as solar energy collector the greenhouse it self and **heat storage the earth**



During the night the greenhouse air **is heated utilizing the heat of earth**





Using a heat pump and water tanks can recycle the irrigation water and stores the heat it in the tanks

Biomass

Agricultural by-products can be used for greenhouse heating

Gasified biomass by thermochemical method can be used for greenhouse heating

Humidity setting

Heating tubes between foliage reduces the relative humidity inside the foliage of plants


Stirring of the greenhouse air reduces the excess moisture in plant area

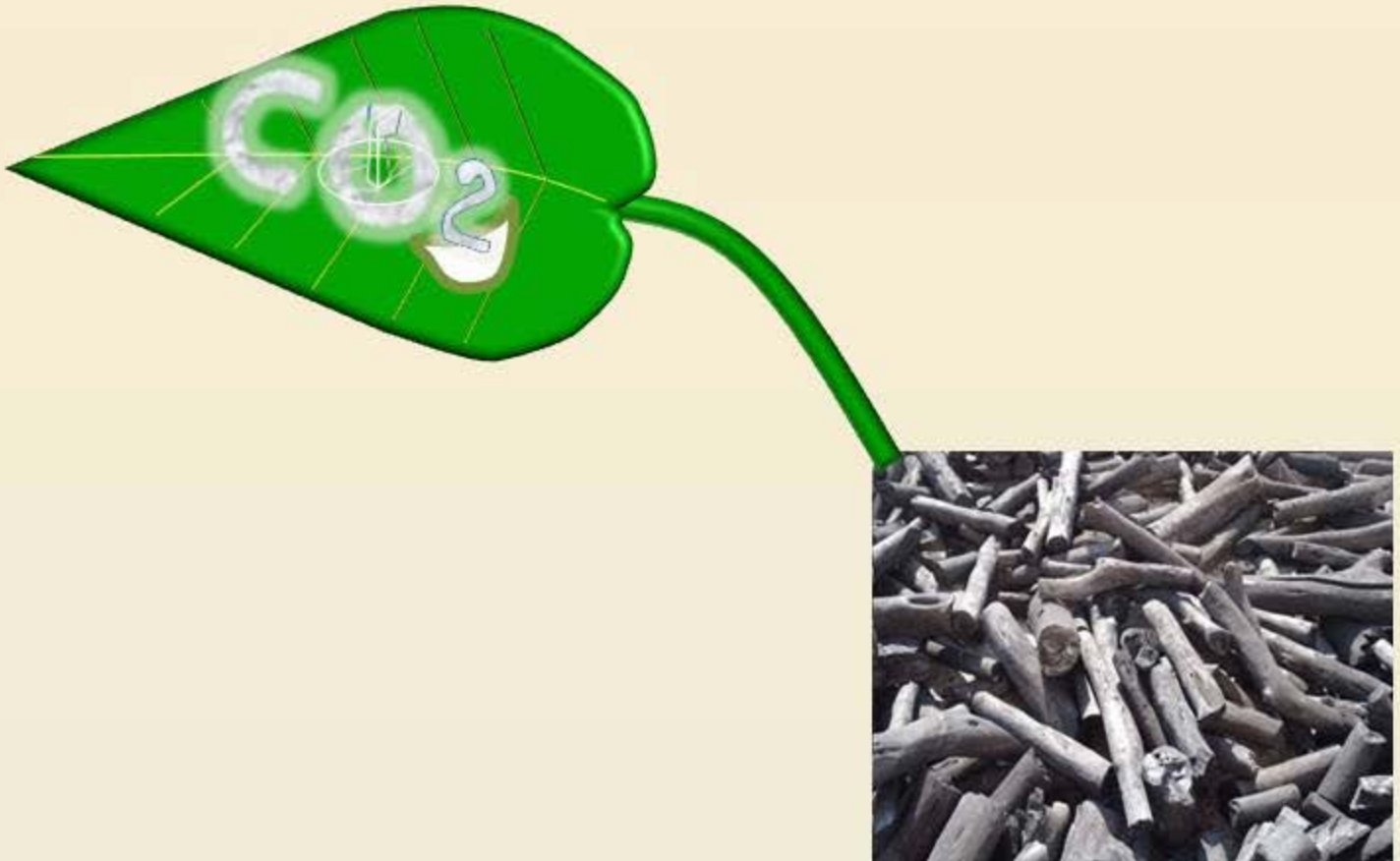

Opening the windows for a while at night and the use simultaneously of the heating system, reduces the relative humidity inside the greenhouse.

Removing the lower leaves favors the air movement through plants

Some crops need moisture to grow well

Mist to create high humidity for rooting of foliated cuttings

Greenhouse air enrichment with carbon dioxide increases production



Air heater for CO_2enrichment

CO_2 enrichment from the exhaust gases after filtering

Liquefied CO_2 for greenhouse enrichment

Centralized control for the greenhouse operation

In General, a modern greenhouse:

must provide the ability to create the **desired environment for the** development and **production of plants:**

- **at the best quality** and
- **at the lowest possible cost of production**

To have low production costs and beneficial economic performance should have made:

- ***proper construction**
- **proper equipment**
- **human resources able to organize**

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* Proper means:

- **possibility to use the advantages of the natural environment**
- **Equipment suitable** for the subject matter **and enabled for energy & resources saving**

Τέλος

The end

Ευχαριστώ για την προσοχή σας

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