

# Gerbera Cultivation in Soilless Media.

Horti - Expo Seminar  
Kunnar, India Sept. 2012

Flourishing gerbera roots in coco-fibers,  
in 4 Liter 'Container'.



**Gerbera -  
Practice & Theory**  
**Selected chapters**  
Growing  
conditions -



First  
lecture

Dr. Yoseph Shoub  
Gerbera Breeding Ltd. Israel

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## Practice and Theory of gerbera cultivation in soilless media -

[www.gerberaisrael.com](http://www.gerberaisrael.com)

This lecture deals mainly with the Growing Conditions in soilless media for the gerbera roots. The roots worth it, as they are the solely suppliers of the water, the oxygen and other important minerals.

In countries with long hot-climate season, like India and Israel for example, it isn't easy to achieve, throughout the year-round, the Optimal Growing Conditions for the above soil organs; *unless water is supplied on time when it is really needed.*

### ***An essential note -***

The gerbera is a 'Self-inductive plant', flowers initiation is not affected by the day length or the temperature.

It is related only to the phenotype growth-rate and is affected by it.

On the other hand, the rate of the plant growth *depends always on the ability of its roots to supply, on time, water containing oxygen and minerals.*

The floriculture industry started historically in Europe, it is well developed now in most of South American countries. Mostly because of the mild climate, labor cost, the development of air transportation, and above all because of the accumulation of the know how.

Never the less; time and experience led us to achieve great economical results in our countries too, by investing in agricultural-research, in developing modern irrigation methods, and by selecting crops and varieties that fit our countries' climate.

This lecture, is also an example for our services, aimed to share with the gerbera growers our experience - by presenting practical methods for getting the production potential of our gerbera varieties\* and at the same time to study the uniqueness character of the gerbera plant.

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\* Our varieties are marketed world-wide solely by Selecta Cut Flowers S.A.U  
E-mail: [info@selectacutflowers.com](mailto:info@selectacutflowers.com)

An intensive modern plant would probably declare:

That in order to get the production potential and the quality-potential, all is needed are the:

*'OPTIMAL GROWING CONDITIONS'*

*(or at least as close as possible)*

It is expected from us, the growers, to know what is good for the plant, and how to do it -

Both in the growing media and in the greenhouse-space.



A photograph of a wooden desk in a room. On the desk are several papers and a folder. Behind the desk is a wooden chair with a yellowish-brown upholstered backrest. A pair of tan work boots sits on the floor in front of the desk. The wall behind the desk is white with some peeling paint, and a green panel is visible on the right side of the wall.

Mr. Grower

The know-how is an accumulated process.  
As long it continues the grower will realize  
in practice how to create the optimal growing  
conditions. Our knowledge and experience is  
offered to our growers wherever they are.

Our Gerbera Varieties do well in  
soilless media, as well as in soil.



‘Rodrigo’ in soilless media (sort of Hydroponics),  
4 months after planting, Colombia, March 2004



Measuring the irrigation volume

Our gerbera plants in raised *organic* soil-beds (25 - 30 cm high), Colombia, 2008

© Dr. Yoseph Shoub

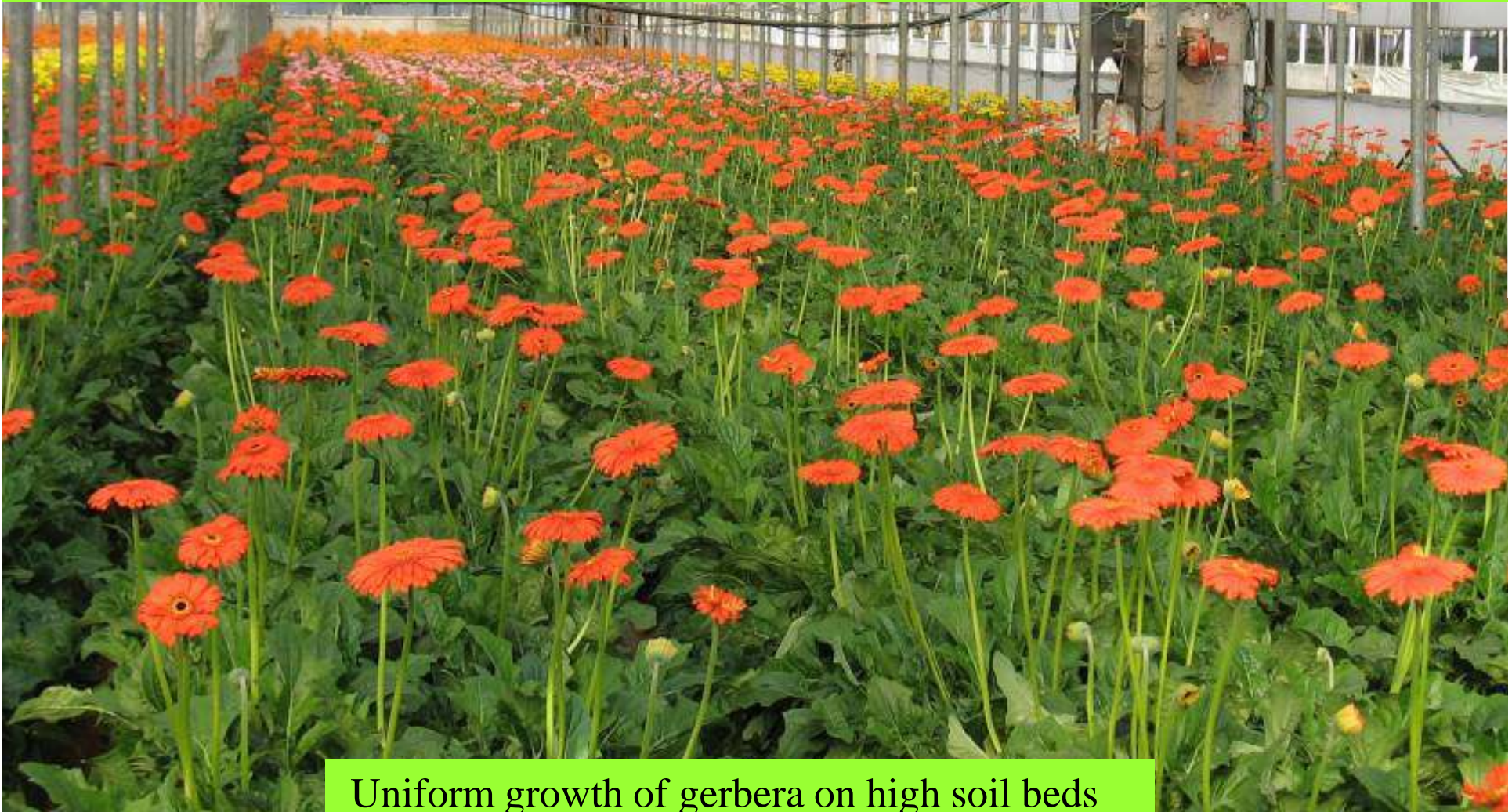




High soil beds are precondition for successful growth of gerbera in soil. Israel, February 2006

‘Marinilla’ in sandy soil-beds, 100 days after planting , Israel November 2007.

*The growing conditions in sandy-soil are almost the same as in Hydroponics,  
but more secure on account of the buffer-capacity of the soil. (see later)*



Uniform growth of gerbera on high soil beds



Raised soil-beds for gerbera, the imported *sandy soil*, covers the original clay soil.

## Soil-beds with our gerbera varieties, Dehradun, Uttarakhand India 2009



25 - 35 liter of  
cultivated soil-bed  
per plant, compare  
to 4 - 6 liter in  
containers



So what is the problem with the soil?

These are the issues a gerbera grower in soilless media should be aware of -

In short !

The morphology: the roots, the leaves, the branches & the crown.

Growth and development.

Water consumption and Irrigation.

Oxygen availability in the soil solution .

The daily plant activities.

Hydroponic conditions.

Salinity.

Practicable methods and aids, for achieving the growing conditions.

Controlling the natural growing conditions: Light ,temperatures, relative humidity.

**Notice** - Running cultivations in soilless media requires - Irrigation systems appropriate for low dripping volumes, and for precise control.

## The gerbera roots system

The roots are the most important organ of the plant, as it absorb and supply water, **oxygen** and other minerals continuously over 24 hours. It includes: Adventitious roots, Secondary roots, and Root hairs.



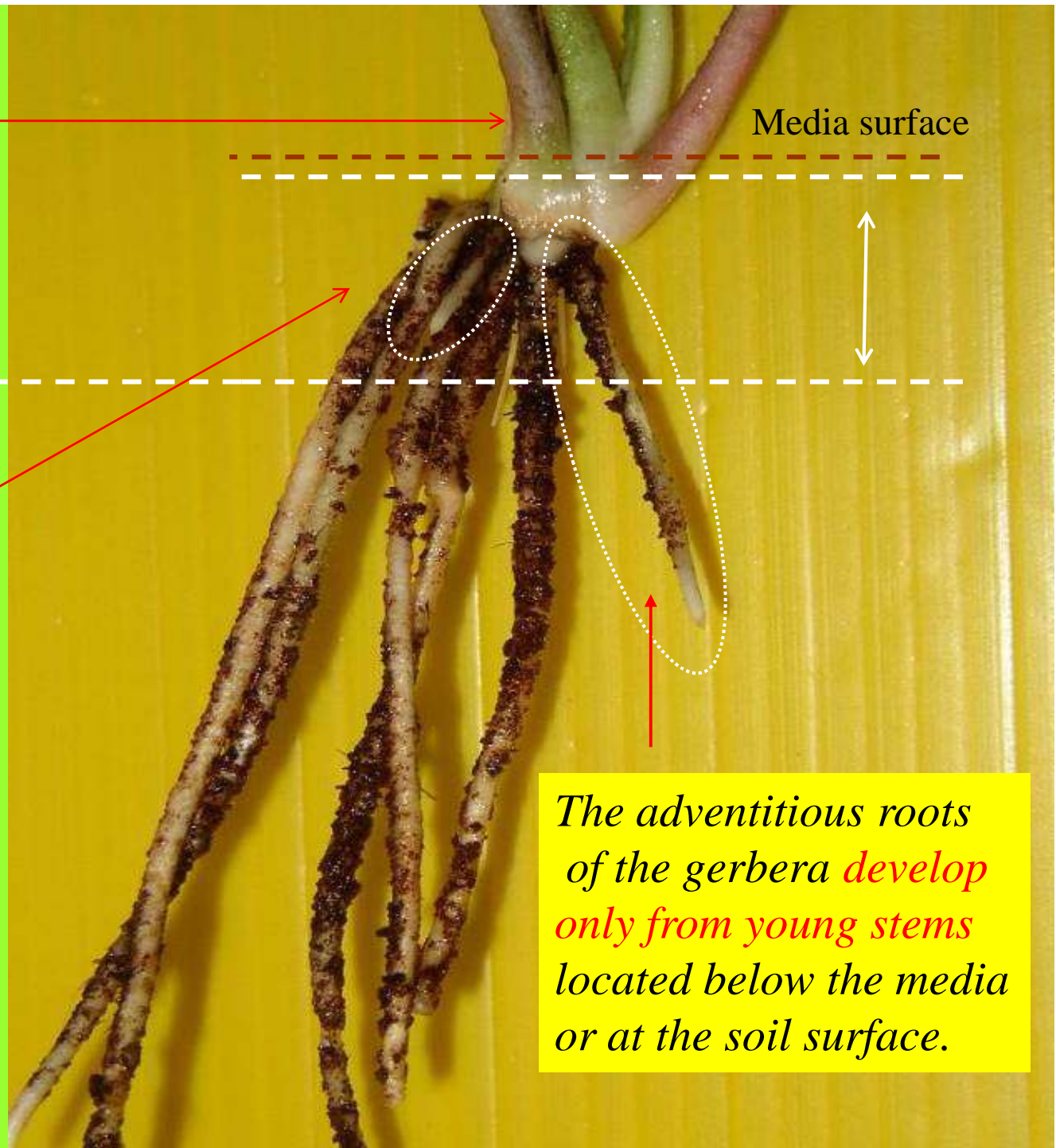
Gerbera root system in soil,  
Ecuador.

*The secondary gerbera roots are active at a soil depth of 0 to 30cm.*

Young gerbera stem  
and its adventitious  
roots.

The growing media  
close to the surface  
is a sensitive layer  
as regards to:

Air / water relations,  
evaporation,  
salt-accumulation,  
and temperature.





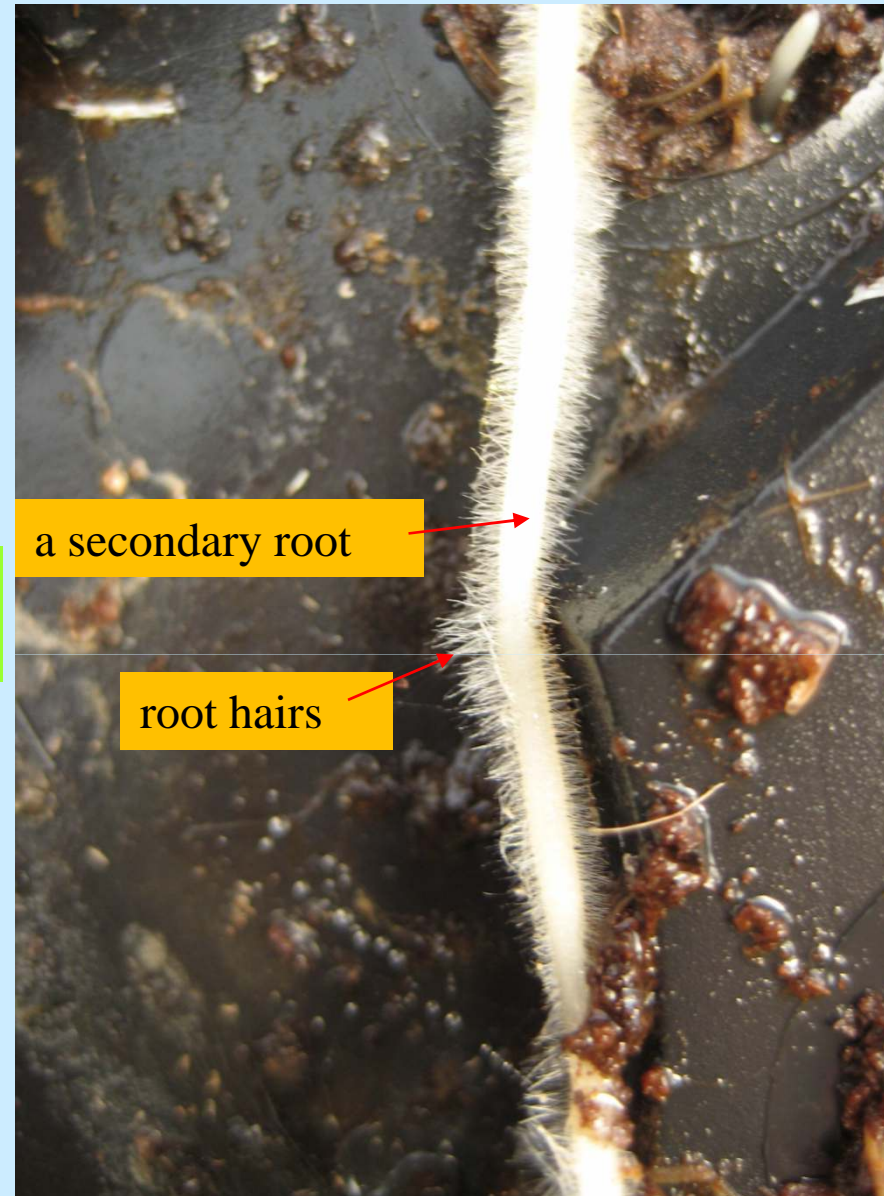
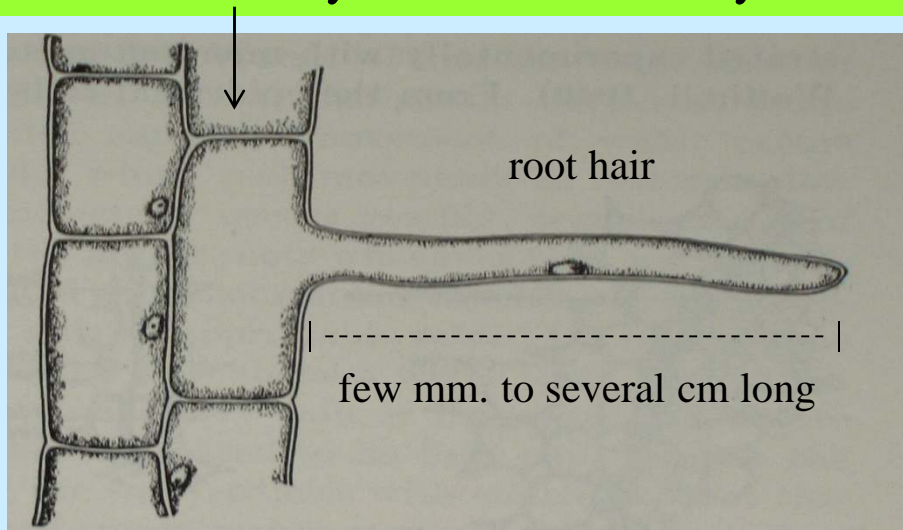
## The root hairs

The root hairs are epidermis cells of the secondary roots.

Their function is to absorb and supply water, **oxygen** and minerals to the above soil organs of the plant.

## The epidermis:

External cells layer of the secondary roots.



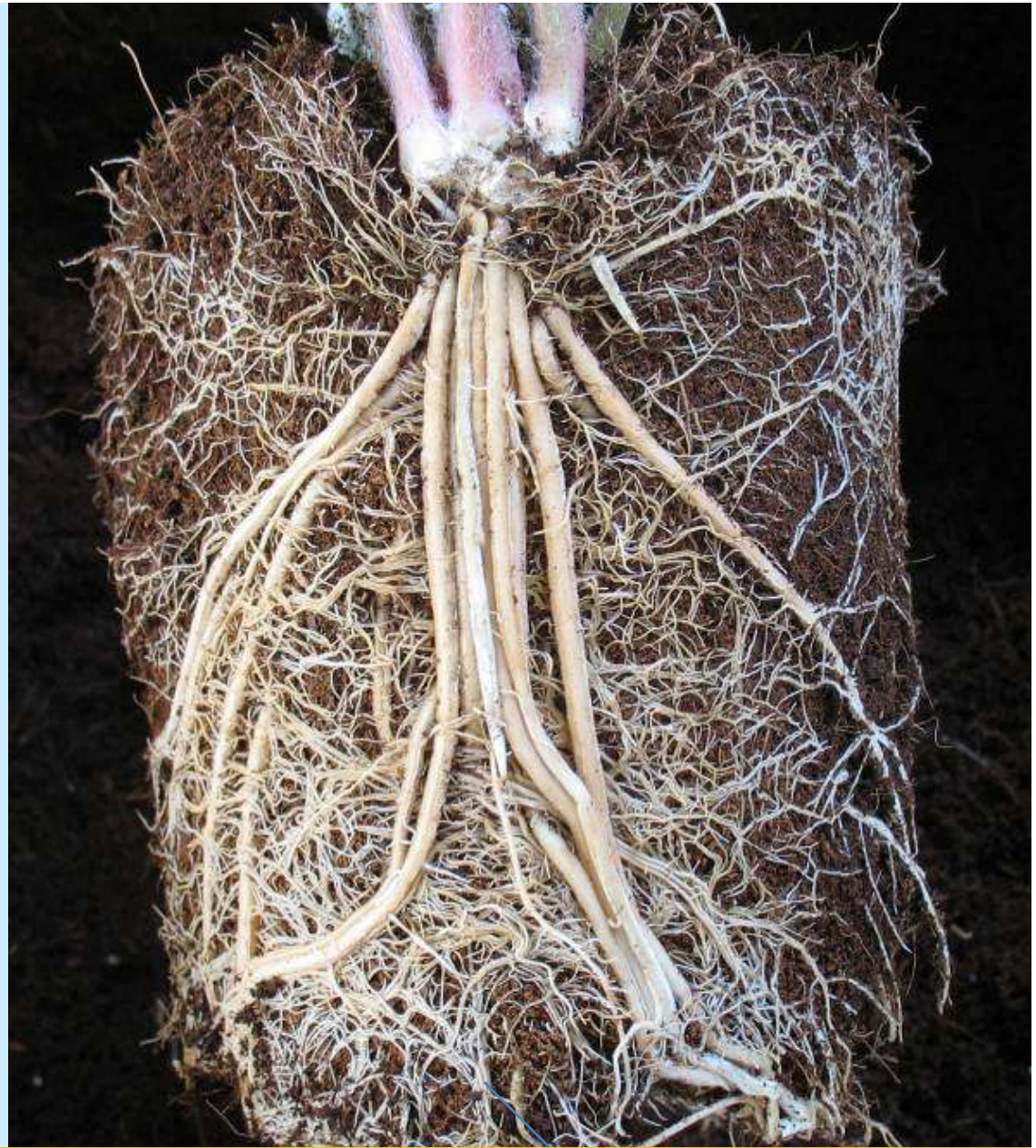
Scheme of external cell-layer of a secondary root.

Root hairs of an apple seedling

Root system of gerbera seedlings  
grown in coco fibers, in 4L  
container.



60 days after planting



Adventitious and secondary roots  
100 days after planting

Absorption of water, oxygen and minerals is performed only by the roots hairs and the root tips



Secondary roots inside the container

Young gerbera seedlings, in coco-peat (4 seedlings in each 4 L. container), 60 days after planting. Gerbera Breeding Ltd. Israel, March 2012.

## Water consumption and Irrigation

Generally saying : A mature gerbera plant consume in Subtropical summer conditions above 500 cc of water per day.

Actually gerbera plant grown in **soilless media** in hot and dry climate, requires daily about 700 -1000cc of water.

*Less water than this minimal daily amounts leads to salinity problems.*

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It is not for us to say the exact amount of water needed to maintain the optimal growing conditions, as it depend on many factors:

Physical factors - *Temperature, humidity, winds, light intensity, media porosity & water holding characters, water quality, and of course the media drainage quality.*

Practical-Controlled factors - *The root's media character, the irrigation system, the drippers volume, the container shape and volume, the irrigation rhythm, the fertilizers quantity, and of course salts accumulation = Salinity, etc.*

## Oxygen availability in the soil solution & plant activity

The oxygen is of utmost importance for the plant as it is involved in almost all its physiological activities.

The atmospheric oxygen (21% of the air) present in the soil pores *is dissolved in the soil solution*, and enters the plant while water is being absorbed by the plant roots.

*This is the only way the atmospheric oxygen can infiltrate into the plant tissue.*

Thus we may say the following practical Philosophy:

*‘The plant’s interest in water, is in the soil-solution and not in the soil-structure’*

## The daily plant activities

Plants utilize - water, light energy, CO<sub>2</sub>, **oxygen** and minerals for the following processes:

**RESPIRATION** - occurs throughout 24 hours, supplying the energy needed for the biological activities. = **The oxidation processes utilizing oxygen.**

**TRANSPIRATION** - occurs throughout the day hours for lowering the temperatures of the leaves, and avoiding radiation damage.

= **Transport of water with oxygen and minerals by the roots from the soil solution.**

**ASSIMILATION** - occurs throughout the day hours.

= **Photosynthesis process produces the sugars needed for the plant development.**

**TRANSLOCATION** - occurs mostly through the dark hours.

= Starts with water, oxygen and minerals-transport from the soil solution to the leaves, for diluting the sugars products, and than translocate the sugars and other nutrients from the leaves to all the growing sites including the roots.

**GROWING & DEVELOPMENT** - occur 24h / 360d many processes involved.



continuous  
growth course

Logical conclusion -

And as plants grow and consume water, oxygen and minerals continuously during 24 hours; it means that for efficient intensive agriculture, it would be better if in practice we will have the ability to control our intensive crops constantly throughout the day and the night as well.

For that we need modern control-irrigation-systems.

Such Sophisticated High-tech Practice is already exist -

The '**SO-AG**' (Sustainable Optimized Agriculture)\*. An irrigation Control system already used in our gerbera breeding farm, and in many other crops in different countries. Saving water saving fertilizers, and getting better production.

\* [www.gerberaisrael.com](http://www.gerberaisrael.com)

[www.auto-agronom.com](http://www.auto-agronom.com)

[www.so-ag.net](http://www.so-ag.net)



## Hydroponic – conditions

*‘Hydroponic-conditions’ are precondition for a successful intensive agriculture.*

Hydroponic conditions in the roots’ growth-volume means:

**Continuous presence of liquid media**, containing oxygen and minerals that contact steadily the root hairs, while the water tension values are : ***close to the ‘Saturation point’.***

**‘Saturation point’**, is a water tension-value in a given wetted volume,  
↓  
when all the capillary spaces in the soil / media are full with water.

**Beware, as this is a critical dangerous point for the secondary roots system.**

Practicable methods for achieving the growing conditions for gerbera -

Achieving the optimal growing conditions for intensive agricultural crops, and in particular for greenhouses crops, means to confront almost every day with the temperatures, the humidity, the aeration, radiation, shading, irrigation, feeding, heating, plant protection, etc.

There are other parameters as the EC of the soil-solution, the oxygen availability in the soil-solution, the water-pressure and the water-movement in the growing media which are important and essential for achieving the optimal growing conditions , but are more sophisticated and it is difficult to control them without automatic tools.

The coming chapters deal with the practicable methods of growing conditions that gerbera growers can achieve and control, and avoid Salinity conditions.

## Choosing the media

Soilless practical advantages as expressed in Coco Fibers Media:

Available and not expensive natural product.

Well experienced media in gerbera cultivation.

Stable organic structure (up to 70% lignin and 30% cellulose).

Dry light substrate, ready for use and easy to wet.

Very effective draining character.

Well aerated, appropriate for high oxygen availability.

Very good water holding capacity.

Its Porous structure enables good capillary water movement.

Enable precise 'Fertigation', etc.

**In sum:** An optimal media for the development of the root system.

Salinity damage  
in drying rice-peels

Normal root growth  
in coco-fibers

Root performance in various media in plastic bags, **Colombia.**



## Choosing the container for soilless media

The advantage of growing plants in soilless media, is the ability to control the drainage.

Physically -The drainage action is pumping air into the root's zone, enriching the media volume with oxygen.

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*A comparison between the physical functioning of the common 'Flower-pot' to the 'Container', is presented in the next slide.*





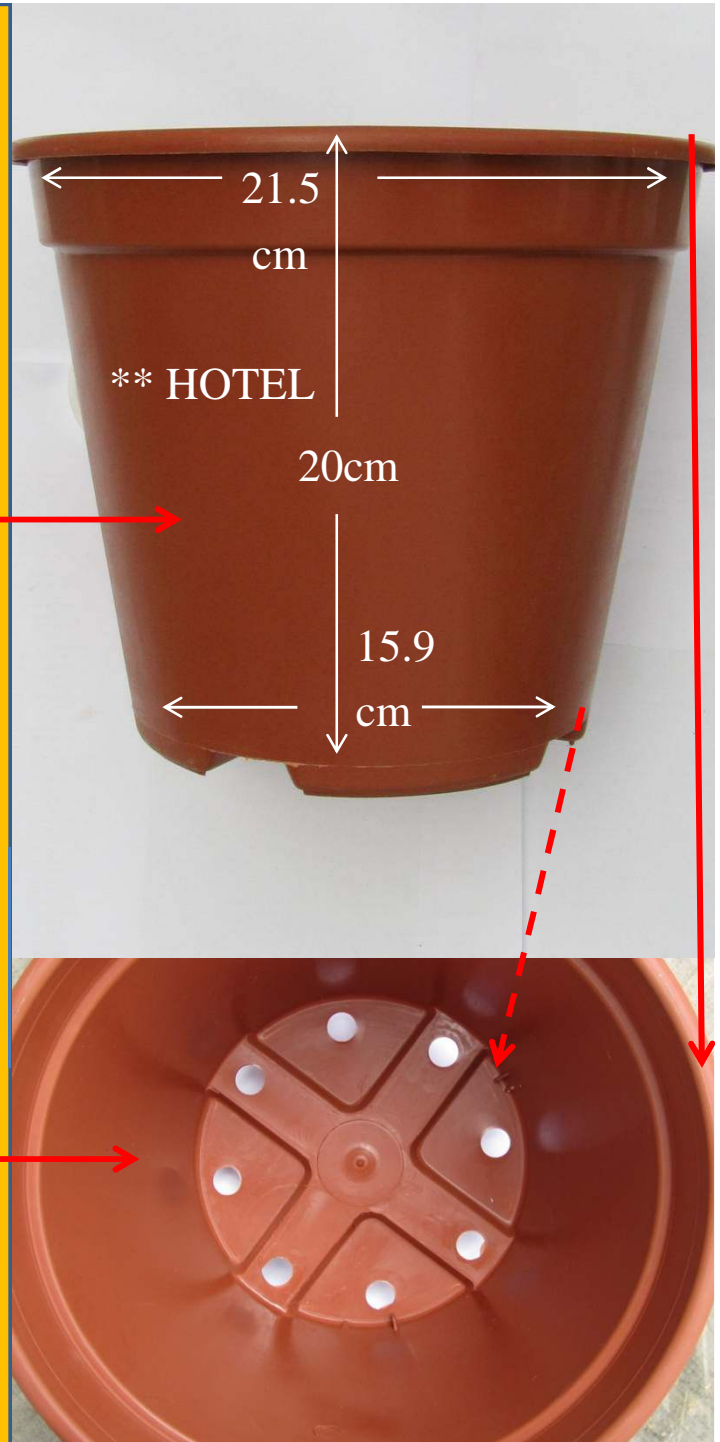
**Drainage-efficiency  
of commonly used tools:  
Container versus Flower  
Pot**

4 Liter      5.5 liter

$$1.35 = \frac{\text{height}}{\text{average width}} = 1.06$$

Drainage efficiency

Drainage holes surface  
3040 mm<sup>2</sup>    1060



## Feeding formulas used in gerbera culture

**A. Common used feeding formula** 800 – 1000 gr. fertilizers / 1000 Liter.

Conductivity	Acidity	Macro elements (ppm)						Micro elements (ppm)				
EC*	pH	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	Bo
0.8 - 1.3	5.5 - 6.2	170	30	220	100	40	60	2.0	0.28	0.26	0.06	0.5

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\* EC added above the EC of the local water

B. **Saving formula** 300 - 500 gr. fertilizers / 1000 L = ~ 45% saving

This formula is used for gerbera grown in containers in our Gerbera Breeding farm.

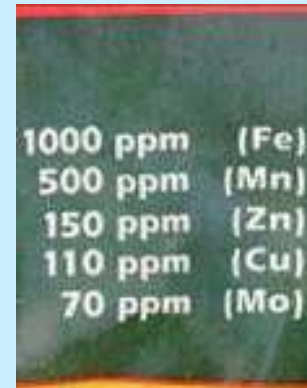
Conductivity EC*	Acidity pH	Macro elements (ppm)						Micro elements (ppm)				
		N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	Bo
0.4 - 0.6	5.5 - 6.2	100	30	110	100	40	60	1.8	0.22	0.24	0.10	0.3

\* EC added above the EC of the local water

Poly-Feed Fertilizer →



+



+

Boron



Automatic 3 Tanks system  
Gerbera Breeding Ltd. Israel

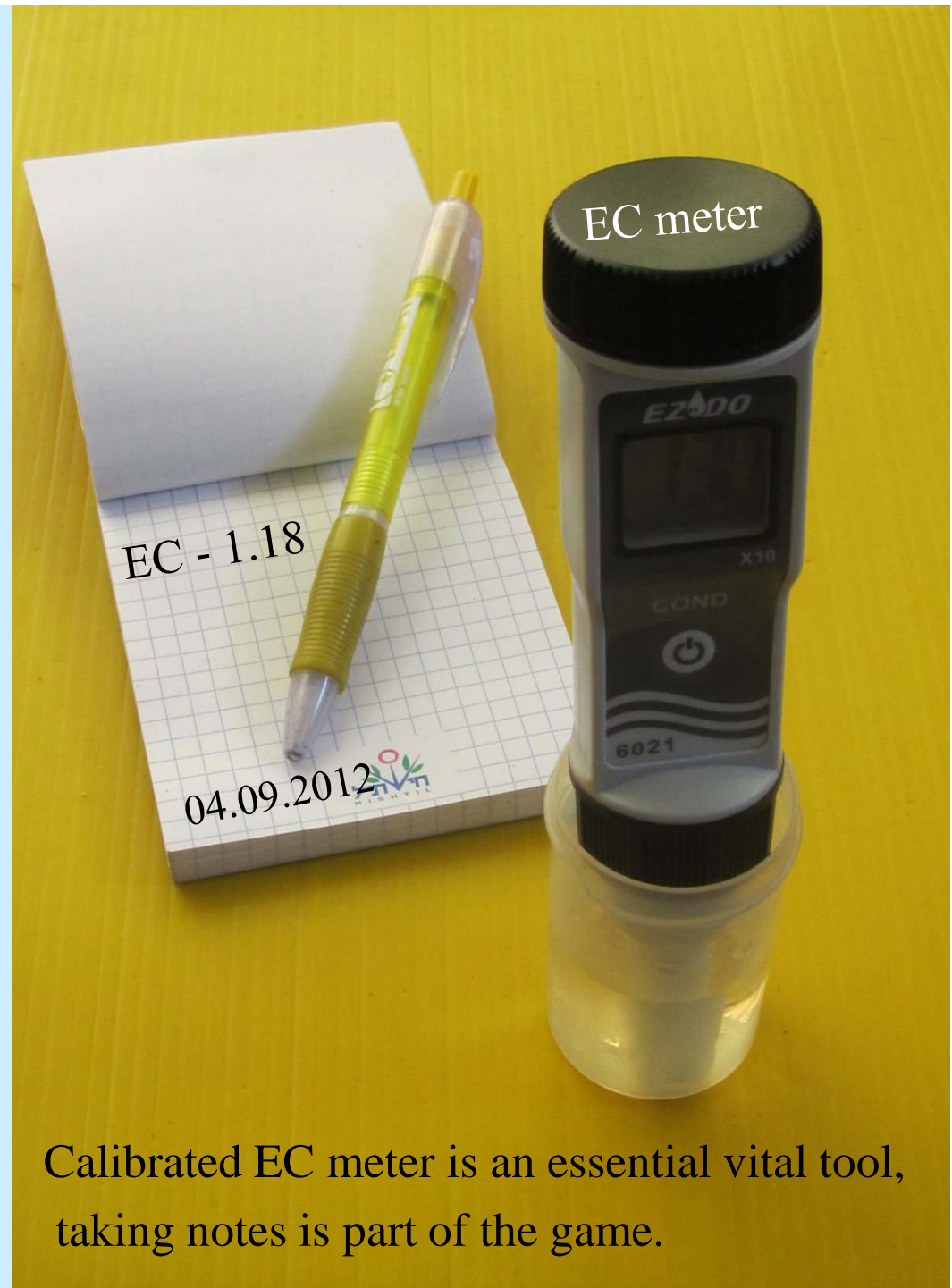


## EC meter

The EC meter is an essential tool for soilless-media-growers. It measures the electrical conductivity in a solution.

Regularly EC measurements of the irrigation and of the drainage-solutions is the safe and a cheap method for **getting decisive information** about the growing conditions at the roots zone.

Therefore; an EC meter must be available all the time in the pocket of a soilless-media-grower.



Calibrated EC meter is an essential vital tool, taking notes is part of the game.

Water Hardness = Calcium



Nitrate & Nitrite

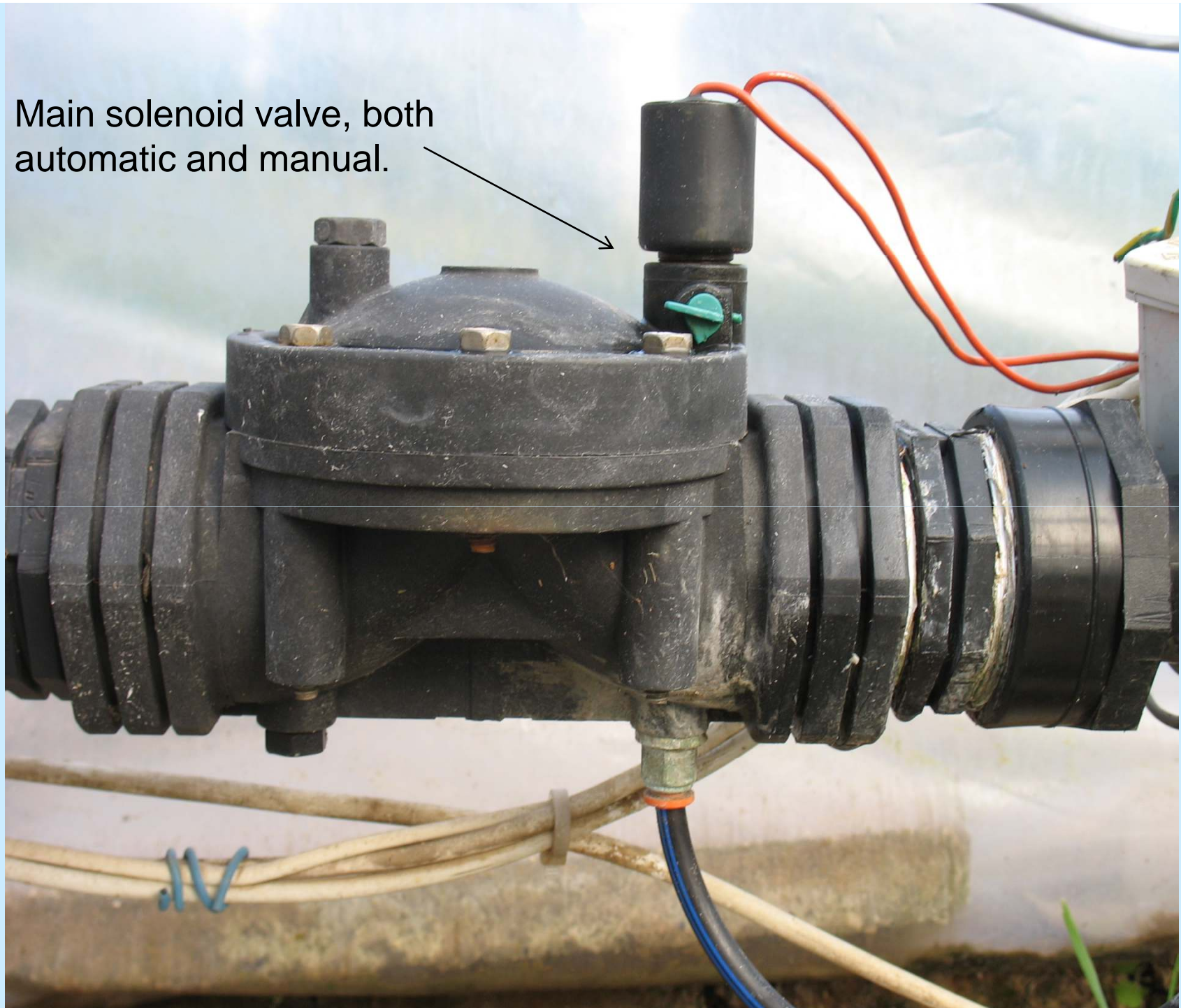
Inexpensive ‘Test strips’ are very useful and accurate for analyzing the quantitative presence of important minerals, both in the feeding solution and in the soil and the drainage solutions.

Fertigation aids –  
Gerbera Breeding Ltd. Israel

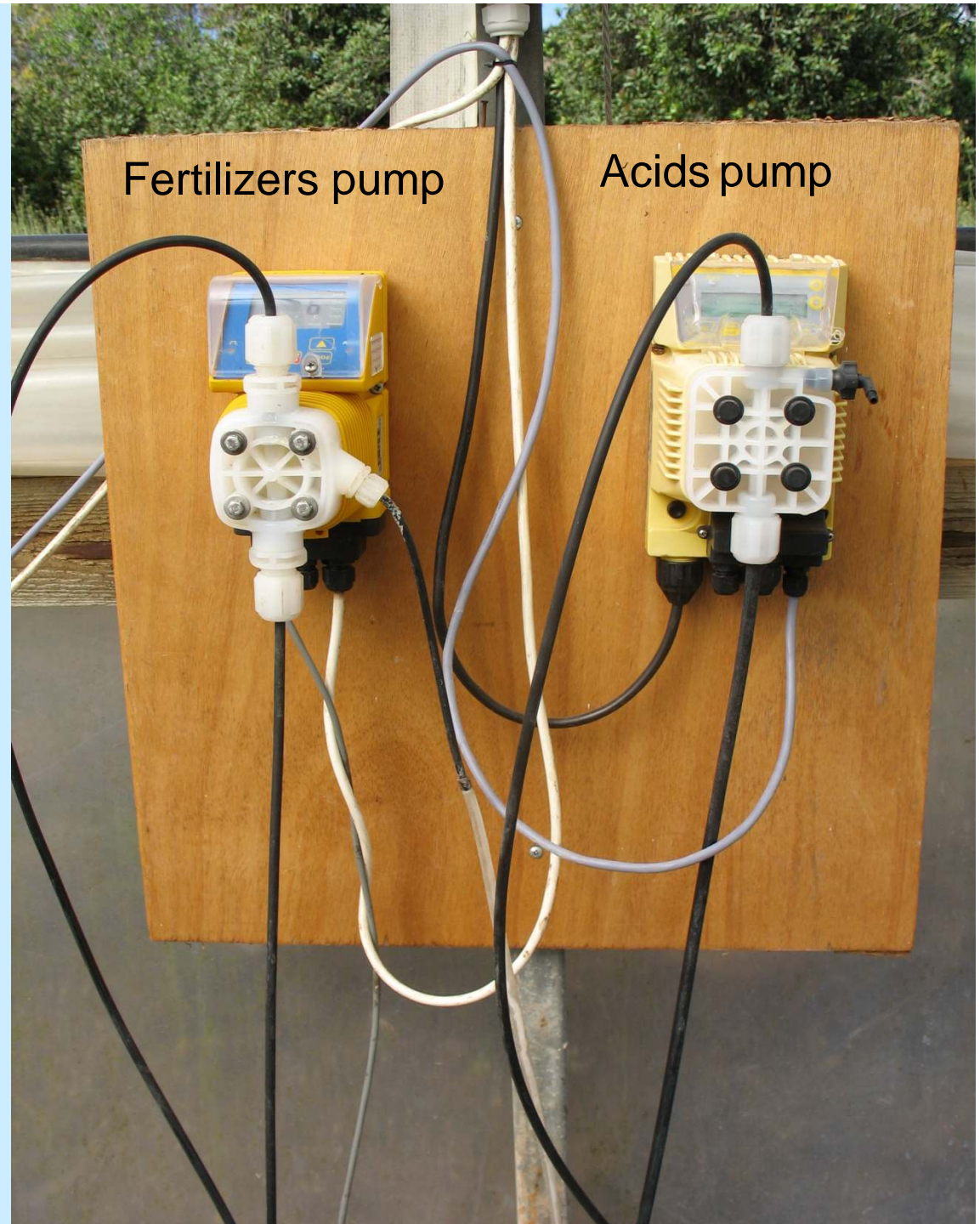
Friendly manual water filter



Main solenoid valve, both  
automatic and manual.



Electric dose pumps for chemicals



One-way injecting  
regulator.

One for fertilizers

One for acids



Injecting valve  
regulator

Water flow



Fertilizers sediments filter





# **SALINITY**

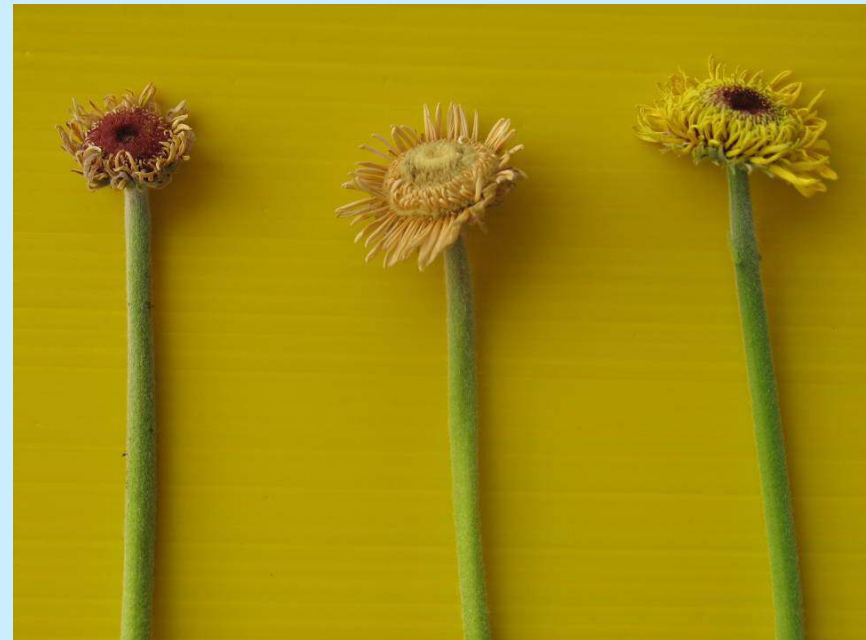
**Salinity** is the enemy of intensive agricultural crops, the economical disease of modern agriculture.

**Every one knows** - that intensive agricultural crops absorb and composed of only 5 - 10% of the minerals, intensively supplied by modern agricultural - **and do nothing about it.**

**Salinity** is caused - in most cases - by these excessed minerals that accumulate in the roots zone, and not because of the soil or the water quality.

**Every one knows it, and yet** the common advice is just to wash the minerals into the aquifers.

Severe salinity damage in gerbera flowers grown in containers.



## What is Salinity

**Salinity is accumulation of excess salts:**

\* In the growing media (soil or other media)

\*\* In the soil solution

\*\*\* And in the plant organs.

A high salt concentration in the root zone create physiological difficulties for water and mineral uptake by the roots.

**It begins** with physical damage to the roots, **continues with** damage to the above-soil plant organs, **and ends** in reducing the production and the quality of the produce.



**Root burn** - Salinity damage in gerbera

The problem is that -

Growers identify salinity symptoms in the above soil organs only long after the roots have been injured.

Sometimes it is too late to avoid the economic damage.



**India**, June 2009 in the soil beds volume.

**Mexico**, February 2008 salty layer in the soil.



**India**, June 2009 total-loss of gerbera plants.

## Salinity in the soil

Under long conditions of salinity in the growing media, the secondary roots are damaged and there are not enough root hairs to absorb the soil solution needed for normal growth and production.



Physical damage to the flowers' petals,



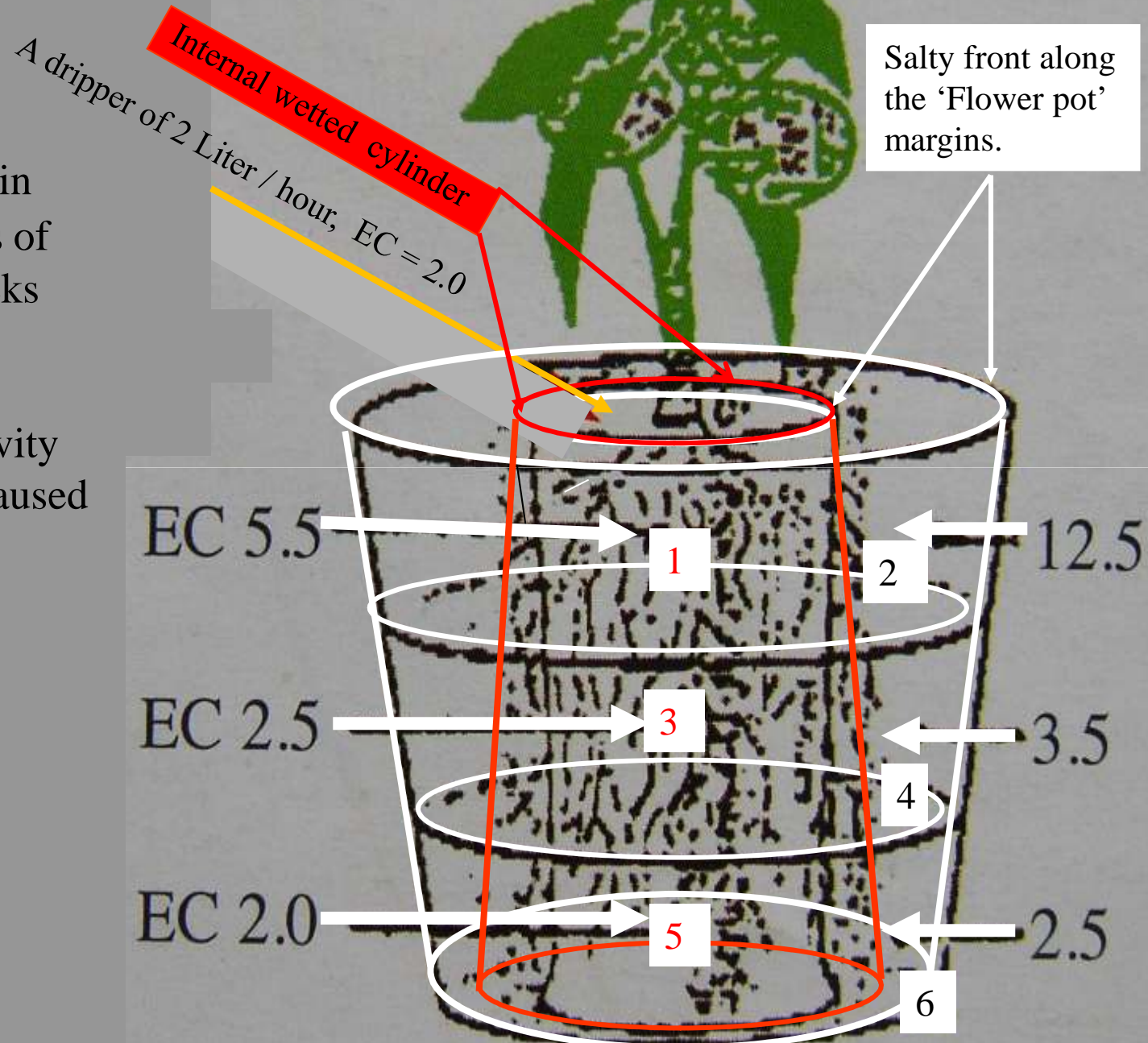
Typical damage in gerberas in soil.

## Salinity performance in gerbera flowers

# Salinity in the soil solution

A real EC situation in 6 different sections of a flower pot, 6 weeks after planting.

Affected by the gravity water-movement, caused by the water flow of 2 Liter / hour.



## Refreshing temporary-wilted plants

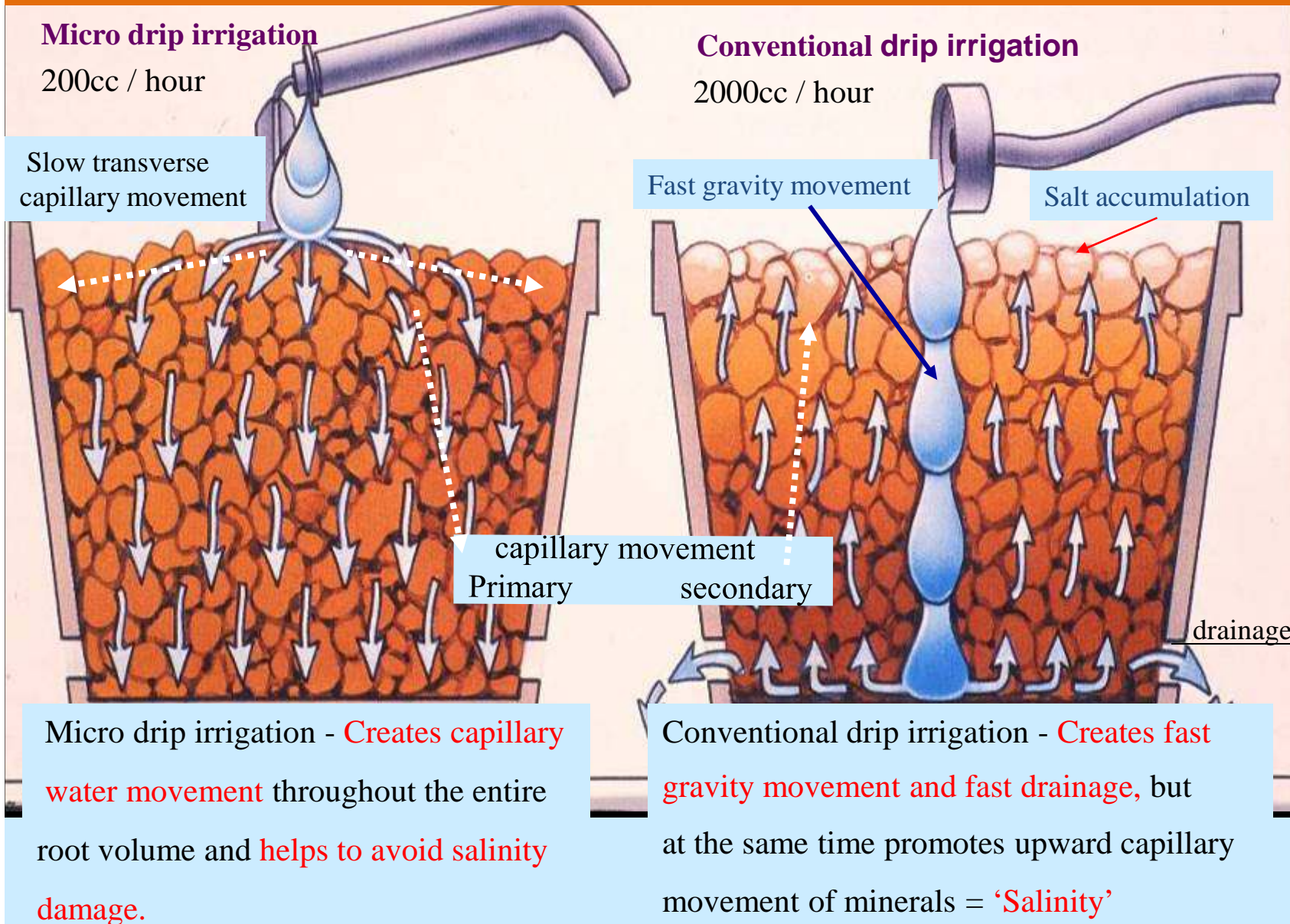
If by any case the media in the container dried up (blocked drippers for example), and the plants temporarily wilted .

But not as a result of salinity,

Than, after normal one-long irrigation ,  
the wilted plants will recover after  
few short hours.



# Water Movement in media - Capillary vs. Gravity - and Salinity Development.



Shoub y. 2004, International Water & Irrigation, vol. 24, 4.



*Place the dripper close to the plant center -*

The capillary movement that starts from the container-center, will transfer the added minerals toward the container margins and downward.


Remember that the growing media close to the surface is a sensitive layer as regards to: Air / water relations, evaporation, salt-accumulation, and temperature.



Evaporation of water and upward mineral diffusion transfers minerals to the soil or to the soilless media surface.



Gypsophila, Ecuador

A photograph of an olive tree in a field. The ground around the tree is covered with a thick, white, crystalline crust of fertilizer salts. The background shows other olive trees and a dry, hilly landscape under a clear sky.

Fertilizer salts accumulating at the soil surface are the continuity of the unseen 'Salty fronts' in the soil.

Olives, Israel

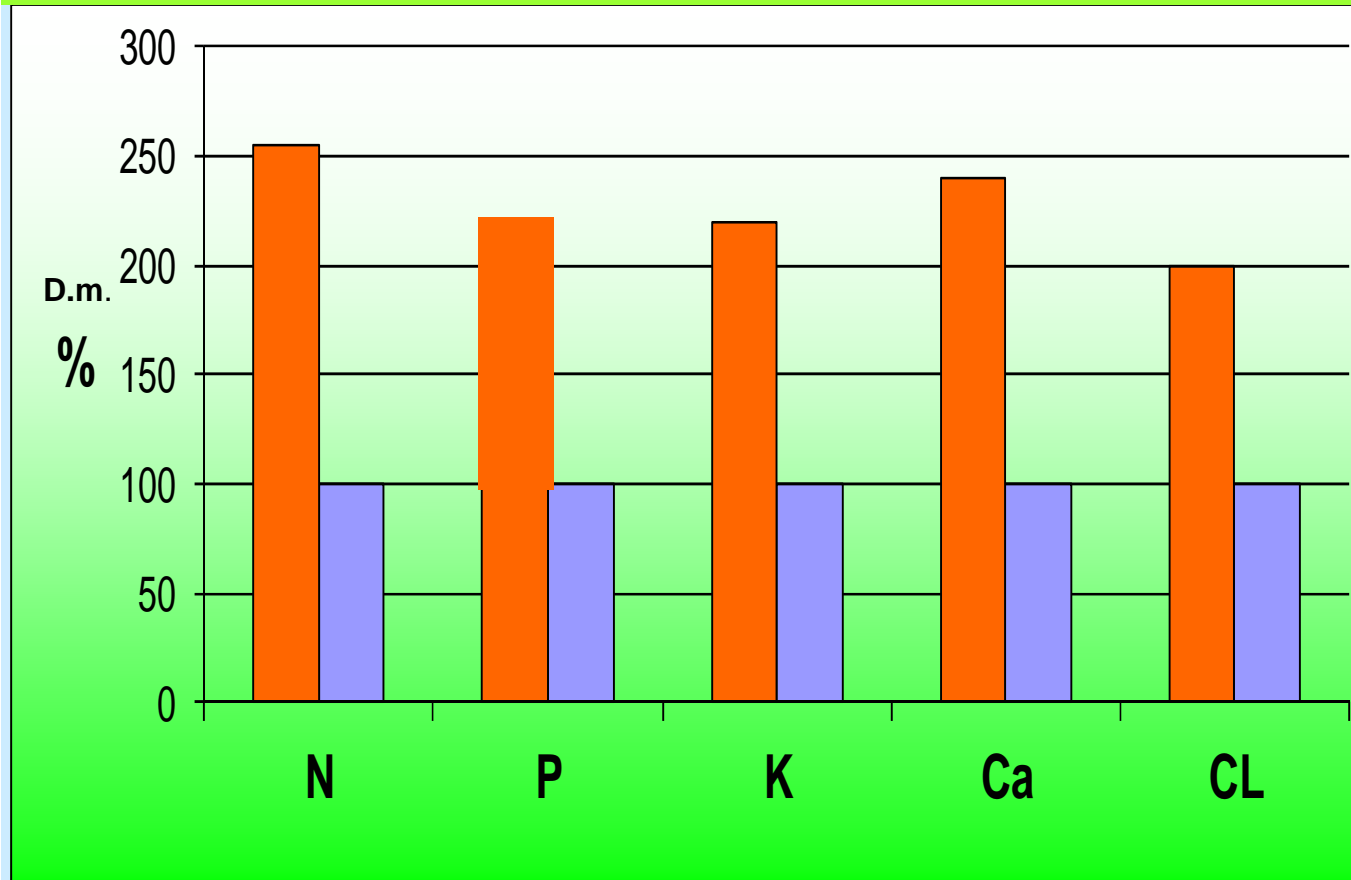
Under intensive agriculture conditions **'Salty fronts'** develop in the soil below any conventional dripper, wrapping around the **'Wetted bulbs'**.

*Usually the growers are not able to see the 'Salty fronts' in the soil !*

Israel 1967



## Salinity in the plant-organs



### Gerbera Leaf analysis

	% of D.M.		
	N	P	K
'Normal'	1.5	0.22	3.3
Salty	3.9	0.50	4.5

Minerals accumulation in gerbera leaves, under 'over-feeding' conditions, vs. normal-fertigation.

Salinity conditions

'Normal conditions'

## Stages of salinity damage in gerbera in soilless-media and in soil:

Sensitivity to diseases increases

Flower production goes down

Minerals accumulate in the leaves, leaves become rigid

Flower diameter is reduced, colors fade

Stems become shorter and shorter

Difficulties of soil solution uptake

Root browning and burning

## Growth & development

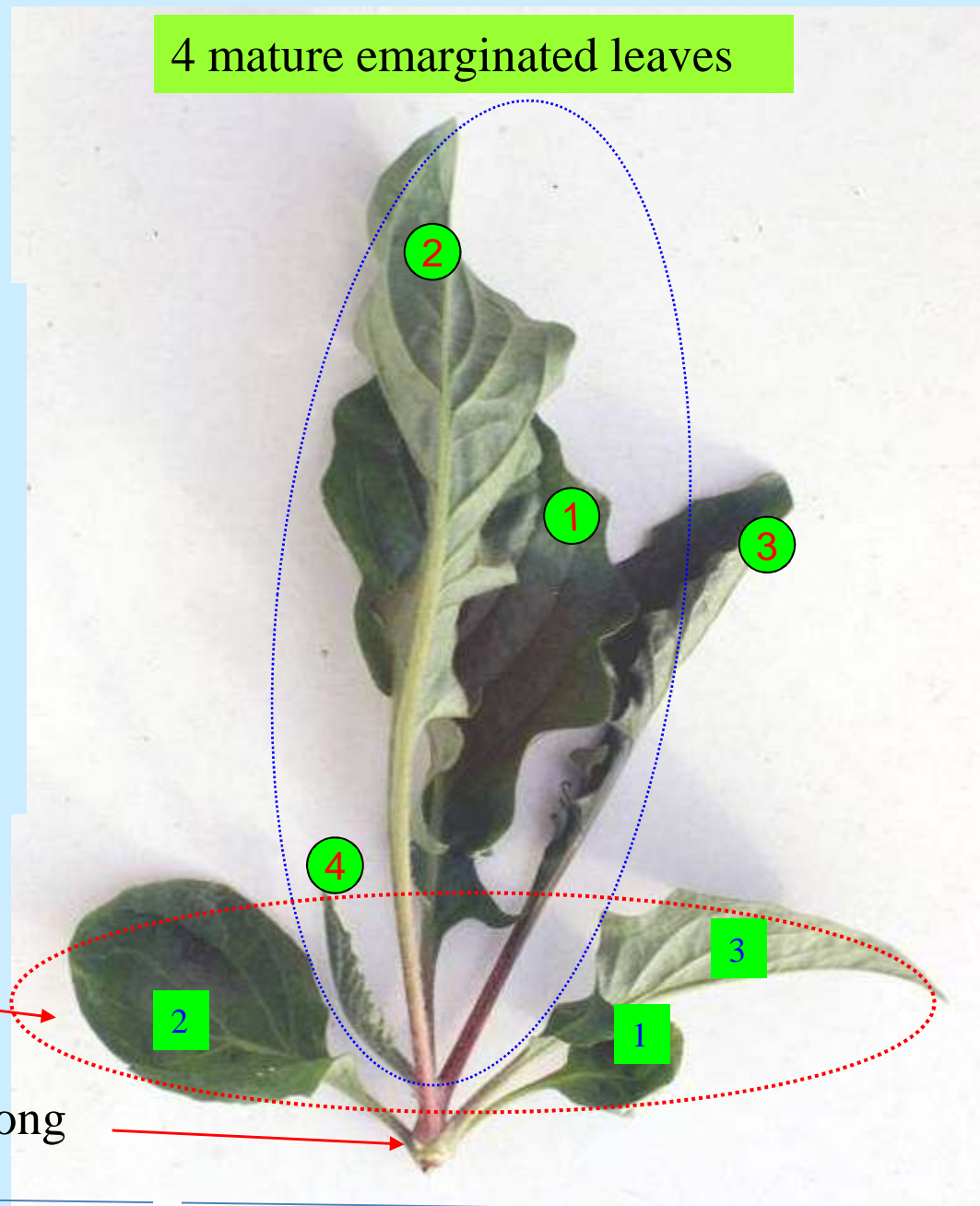
The leaves -

A gerbera stem carries only 4 mature leaves.

The mature leaves are connected to a short stem 3 to 5mm long.

3 round juvenile leaves \*

Young short stem 3 - 5mm long



\* Round juvenile leaves are present only on sprouting seedlings and on laboratory plantlets.

The image shows two oak leaves on a wooden surface. The leaf on the left is green and has a lobed shape. The leaf on the right is yellow and also has a lobed shape. A small, yellowed leaf is attached to the stem of the older leaf. The background is a wooden surface with a vertical blue bar on the right side.

Active leaf

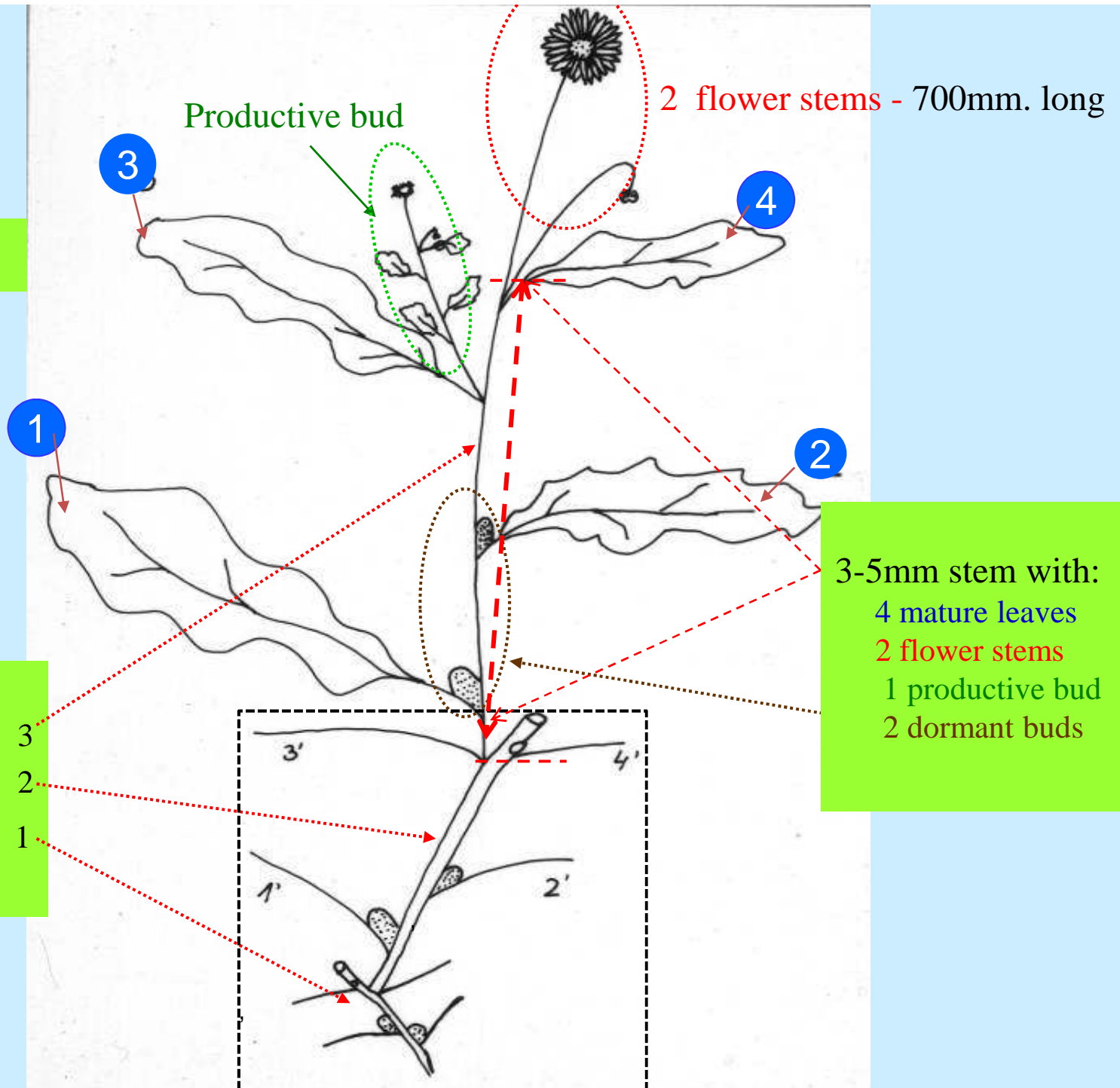
Older leaf

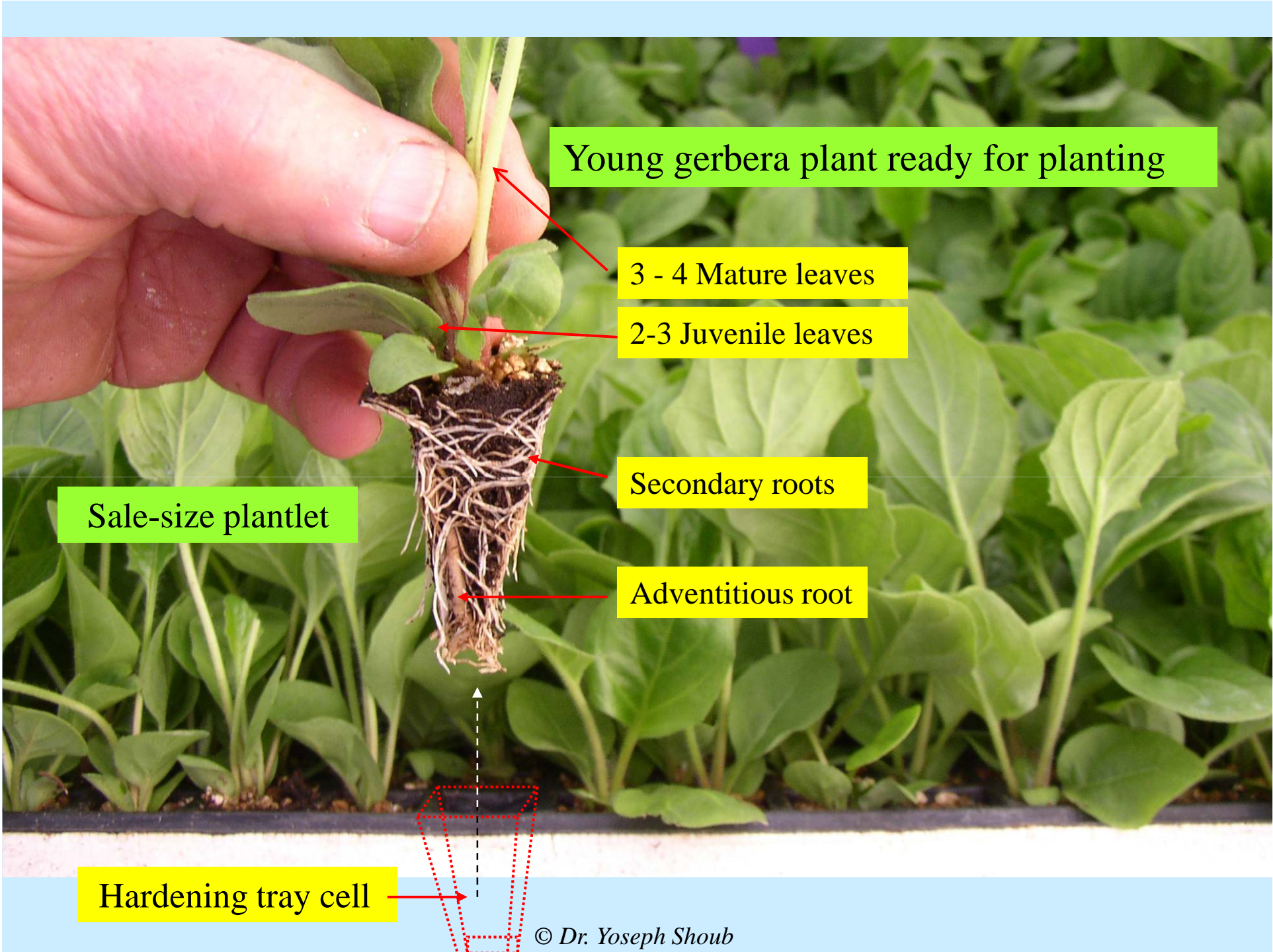
Better to remove the non-active old leaves



## The branches

Scheme of a branch  
composed of  
3 stems





Young gerbera plant ready for planting

3 - 4 Mature leaves

2-3 Juvenile leaves

Secondary roots

Adventitious root

Sale-size plantlet

Hardening tray cell

*The gerbera is a 'Self-inductive plant'*

flowers initiation is not affected by the day length or the temperature.  
It is related only to the phenotype growth-rate and is affected by it.

On the other hand, the rate of the plant growth  
**depends always** on the ability of its roots to supply on time,  
water containing oxygen and minerals.

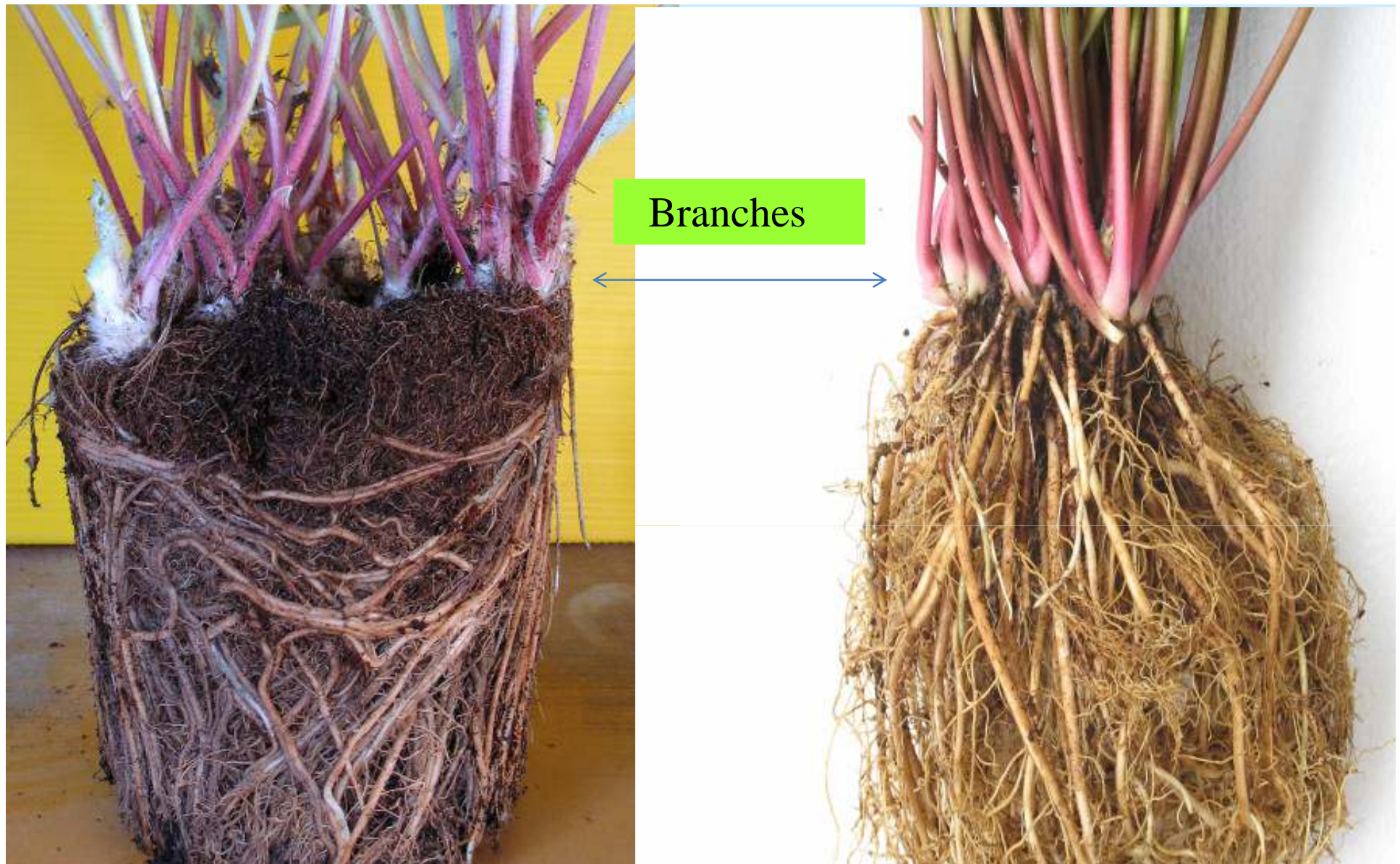
**Practically** it means that optimal growing conditions along the growing  
period, **enhance flowers production.**

Gerbera seedling under optimal growing conditions - 6 weeks after planting already has 2 flowers and a new productive stem.





10 weeks after planting and the seedling already has more than 2 stems.



Root system of 2.5-year-old gerbera plant developed in coco fibers in 4 liter container.

Left: actual situation at the container

Right: washed out roots system

## The crown

The gerbera crown is composed of crowded, compressed branches.

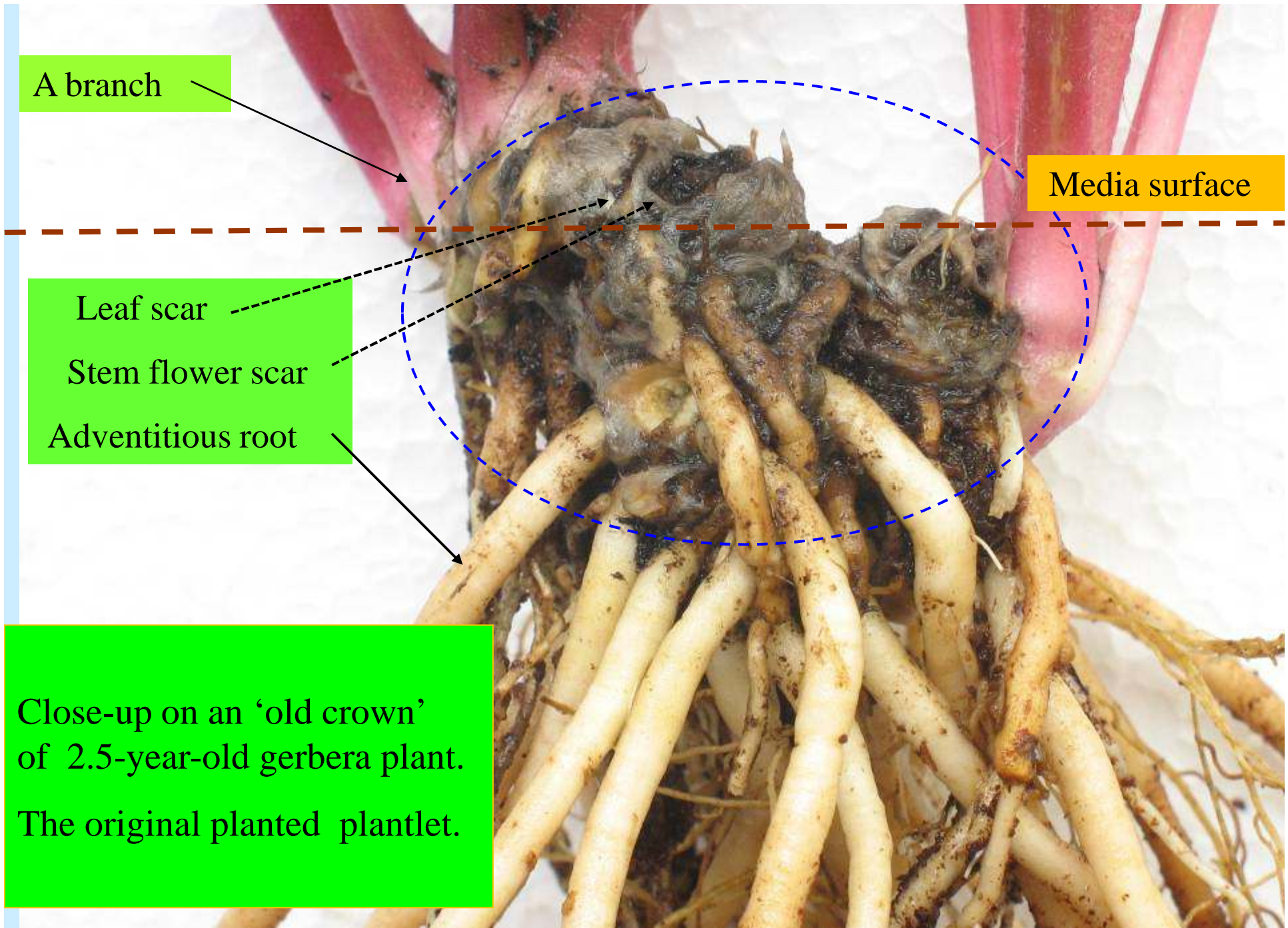
Adventitious root

Secondary roots



A compressed branch without its leaves

Young crown



A branch

Media surface

Leaf scar

Stem flower scar

Adventitious root

Close-up on an 'old crown'  
of 2.5-year-old gerbera plant.  
The original planted plantlet.



Throughout a period of a year and a half, under optimal growing conditions, a gerbera plant produces many branches, many leaves and many roots.

Toward the end of a period of 2.5 years the roots fill up almost totally the container volume.

This situation is encouraging leaves elongation above the efficient length, delaying the growth rate, and decreases the flowers production and their quality.

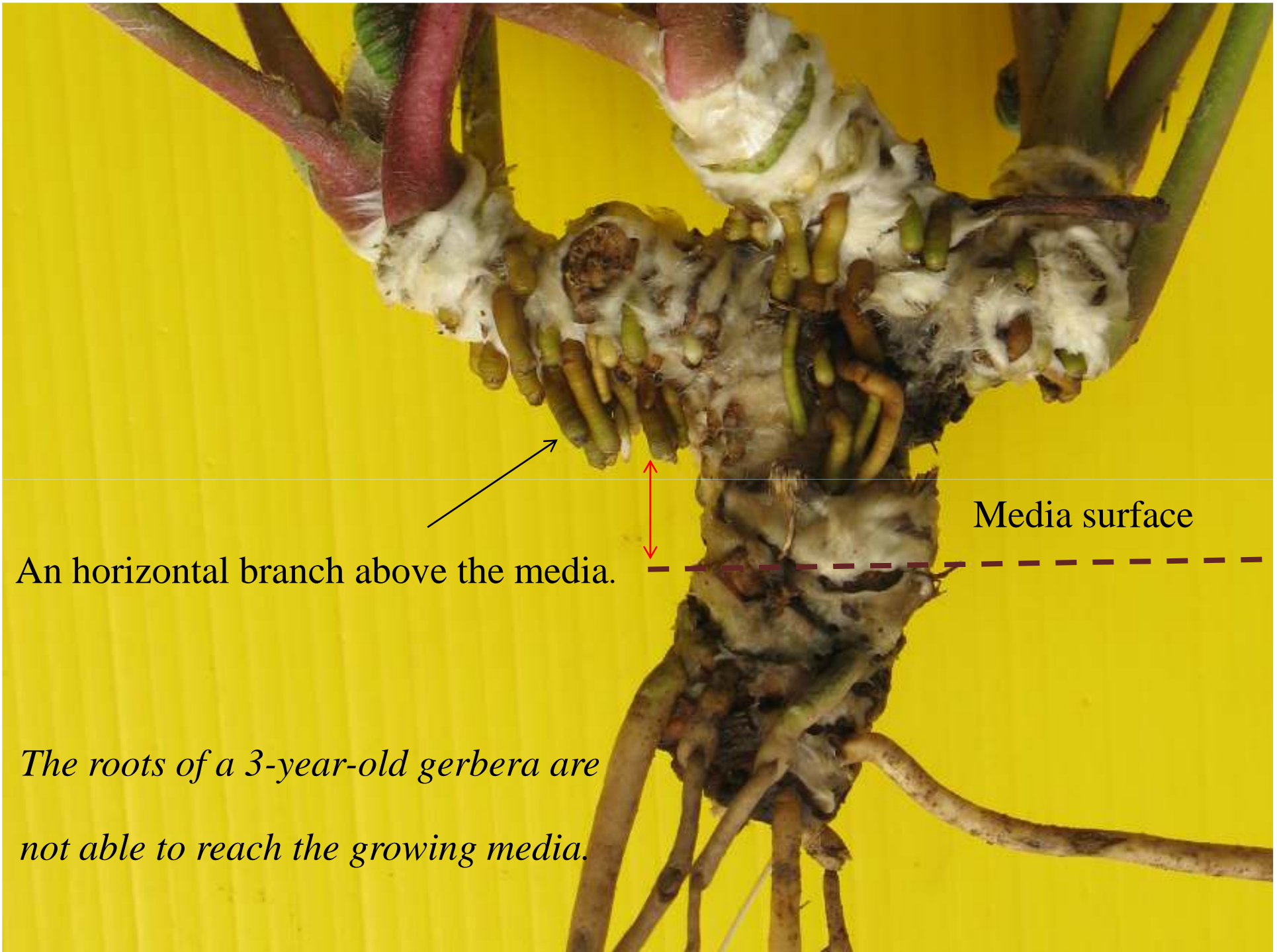


Marinilla 2.5 years old in 4 Liter container

Along the growth period of 2.5 years , the gerbera plant is developing below the media surface, horizontal branches that grow from the container center, towards the container margins.

This kind of growth creates **Un-productive** ‘arms’, covered with many scars of historical- flowers-stems and leaves.





Media surface

An horizontal branch above the media.

*The roots of a 3-year-old gerbera are not able to reach the growing media.*



Many un-productive old crowns

An 'old' un-productive split-up gerbera plant, Colombia.

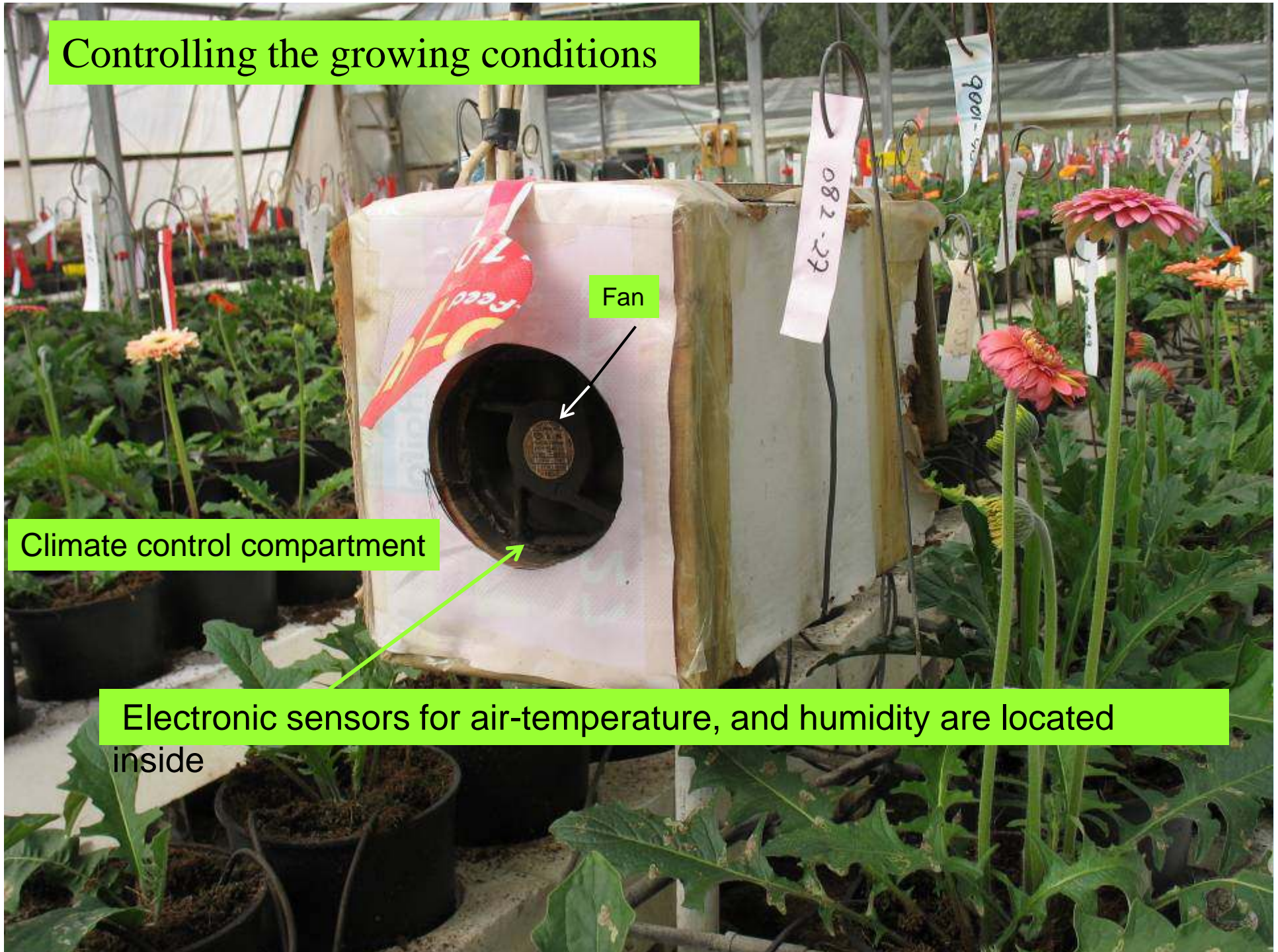
© Dr. Yoseph Shoub

## Controlling the growing conditions

Fan

Climate control compartment

Electronic sensors for air-temperature, and humidity are located inside



Natural sunlight is important growth factor :

It activates photosynthesis

It increases water and minerals uptake

It increases resistance to diseases , and more.....

Therefore, it affects the growth, the production and the qualities.

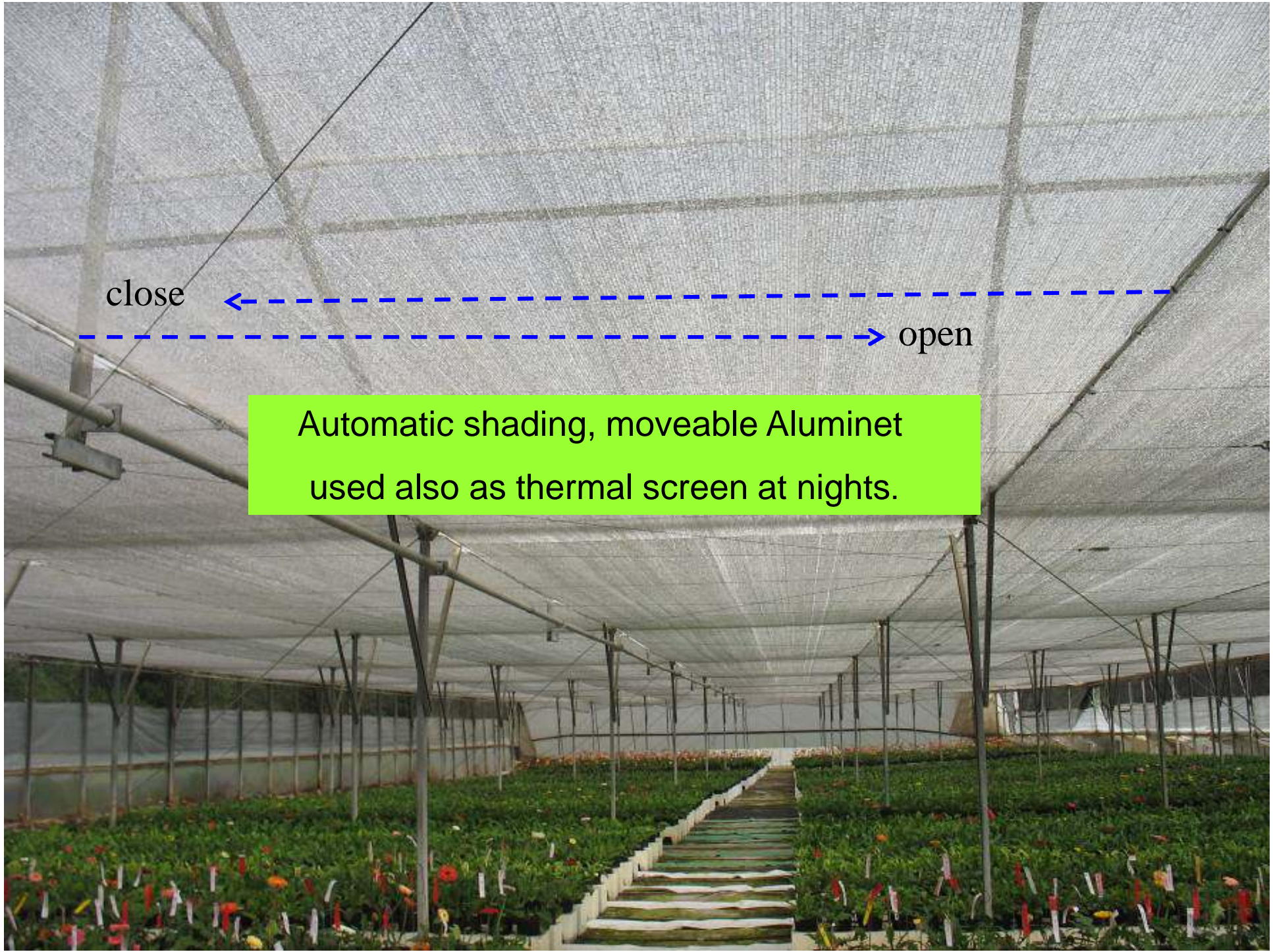
*In fact, out of the total direct sunlight, only 2-3 % is transformed into photosynthetic energy.*

close



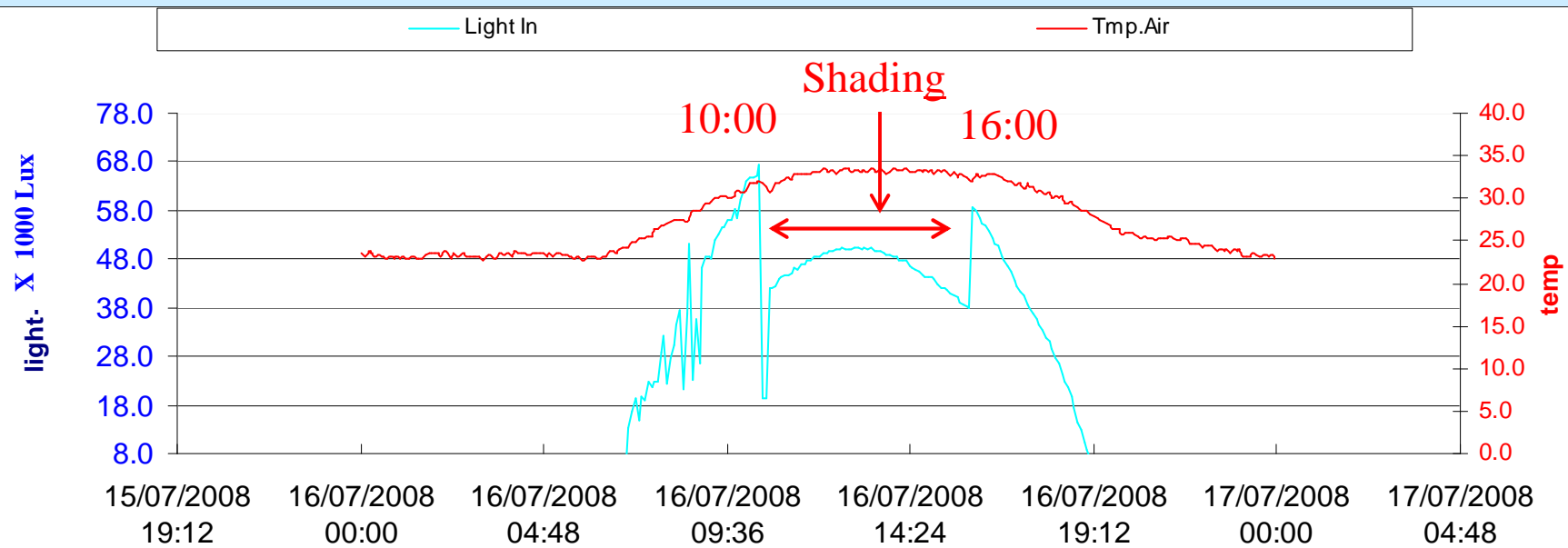
open

Automatic shading, moveable Aluminet  
used also as thermal screen at nights.









Light-intensity and temperatures in a controlled greenhouse,  
Gerbera Breeding Ltd. July Israel 2008

# Air Temperatures

Temperature range of 8 – 38C is acceptable for gerbera culture.

Day temperatures of 17 – 28 C are optimal for high quality growth & blooming.

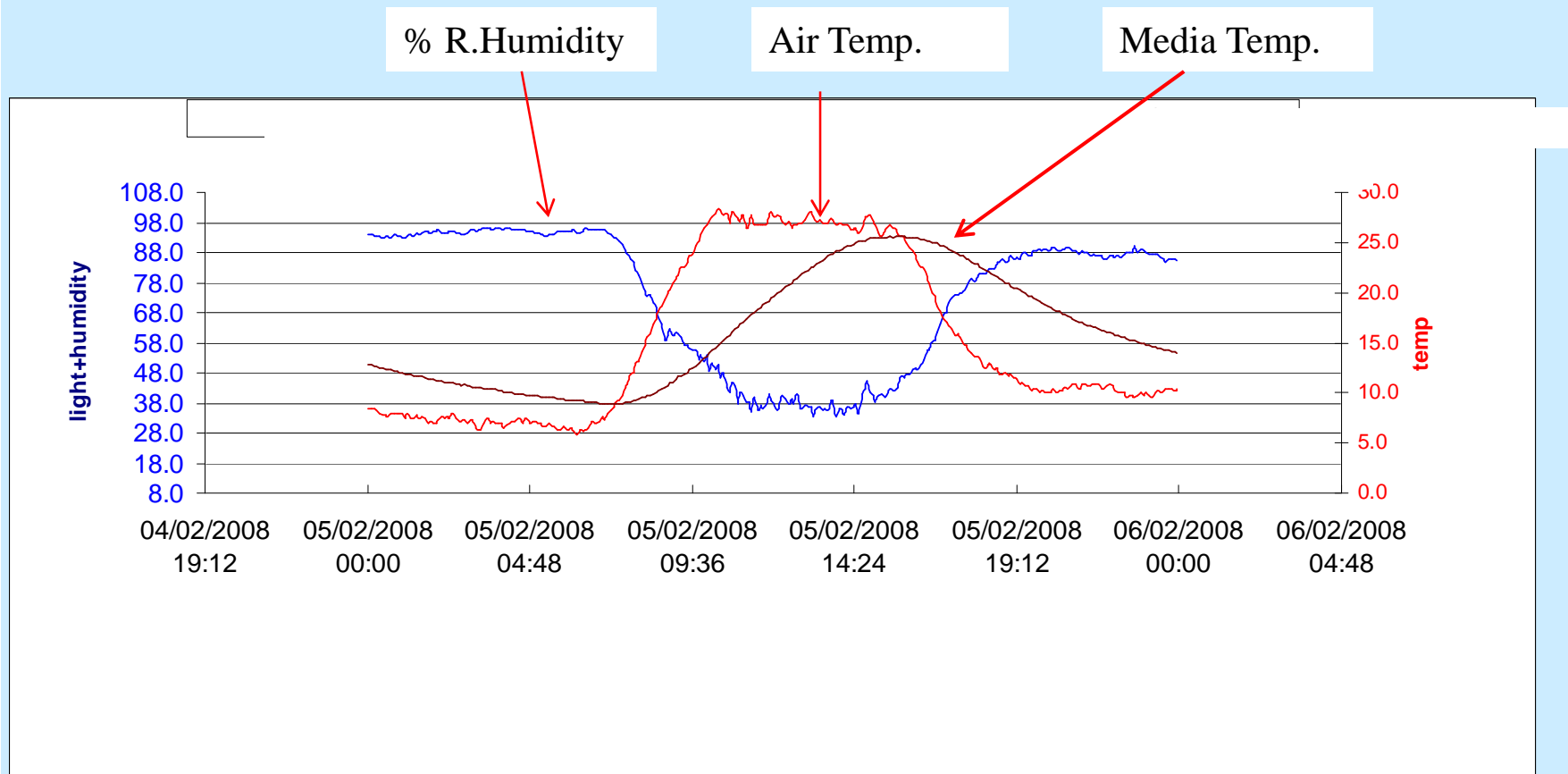
Night temperatures of 10 - 18C are optimal for growth and for high quality stems and flowers.

## Practical remarks:

Night temperatures above 23 - 25C decrease flowers & stems qualities.

Night temperatures of 5 -10C for very long period, delay the growth, and can create malformed flowers.

Temperatures of 0 - 4C for long period, stop the growth and can cause even plants death.



Relative humidity, air temperatures, *and the temperatures of coco-peat media* in 4 L. containers, in a controlled greenhouse. Gerbera Breeding Ltd. Israel February 2008.

## Optimal relative humidity for gerbera

The considered optimal relative humidity for gerbera during day time is 60% to 85%.

Within the optimal range, the plant transpire, absorb water, minerals and CO<sub>2</sub> without any difficulties. Therefore, in controlled greenhouses, gerbera plants develop properly and produce lots of quality flowers.

However, in practice the average relative humidity during summer days in our greenhouses is around 40% to 60%, (with some extreme days even with 25%);

*but water supply on time, avoids any decrease in production and quality.*

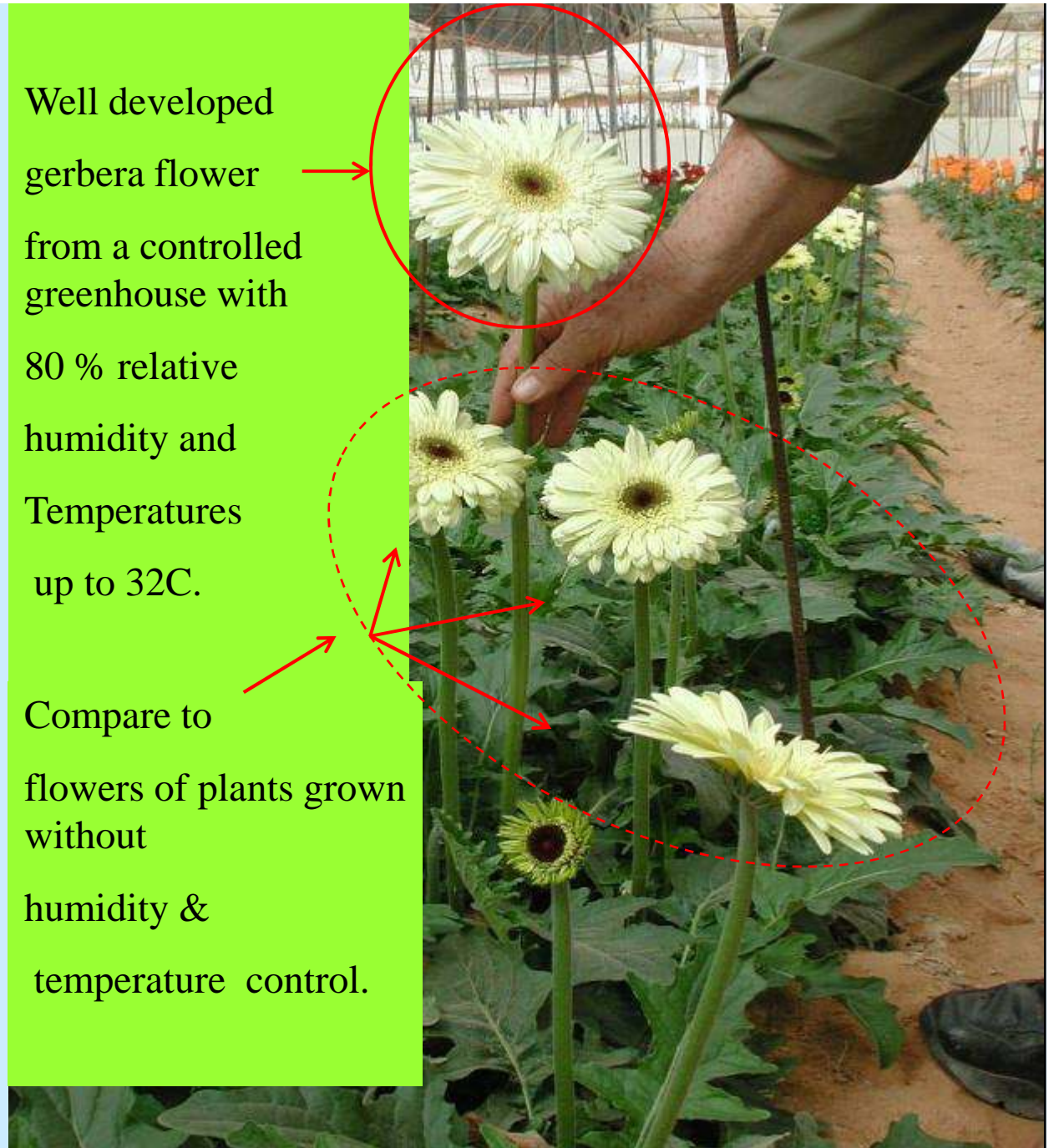
***Notice - Very low humidity, resulted of dry hot winds, can cause damage like salinity.***

Gerbera trials March 2006  
Arava region, Israel.

The climate in in this southern region throughout the year is dry, and the summer is very hot .

Well developed  
gerbera flower  
from a controlled  
greenhouse with  
80 % relative  
humidity and  
Temperatures  
up to 32C.

Compare to  
flowers of plants grown  
without  
humidity &  
temperature control.





The end