Gerbera -

Practice & Theory

Selected chapters

A. Morphology

First lecture

Dr. Yoseph Shoub

Gerbera Breeding Ltd. Israel

Knowing the Gerbera - The Practice and the Theory

Introduction

Our gerbera varieties produce flowers of high quality by many growers, in different countries under diverse climate conditions.*

For getting the production and the quality-potential of our gerbera varieties, the growers have to create, as close as possible, the optimal growing conditions;
In the media for the roots system, and in the greenhouse-space for the above-soil-organs.

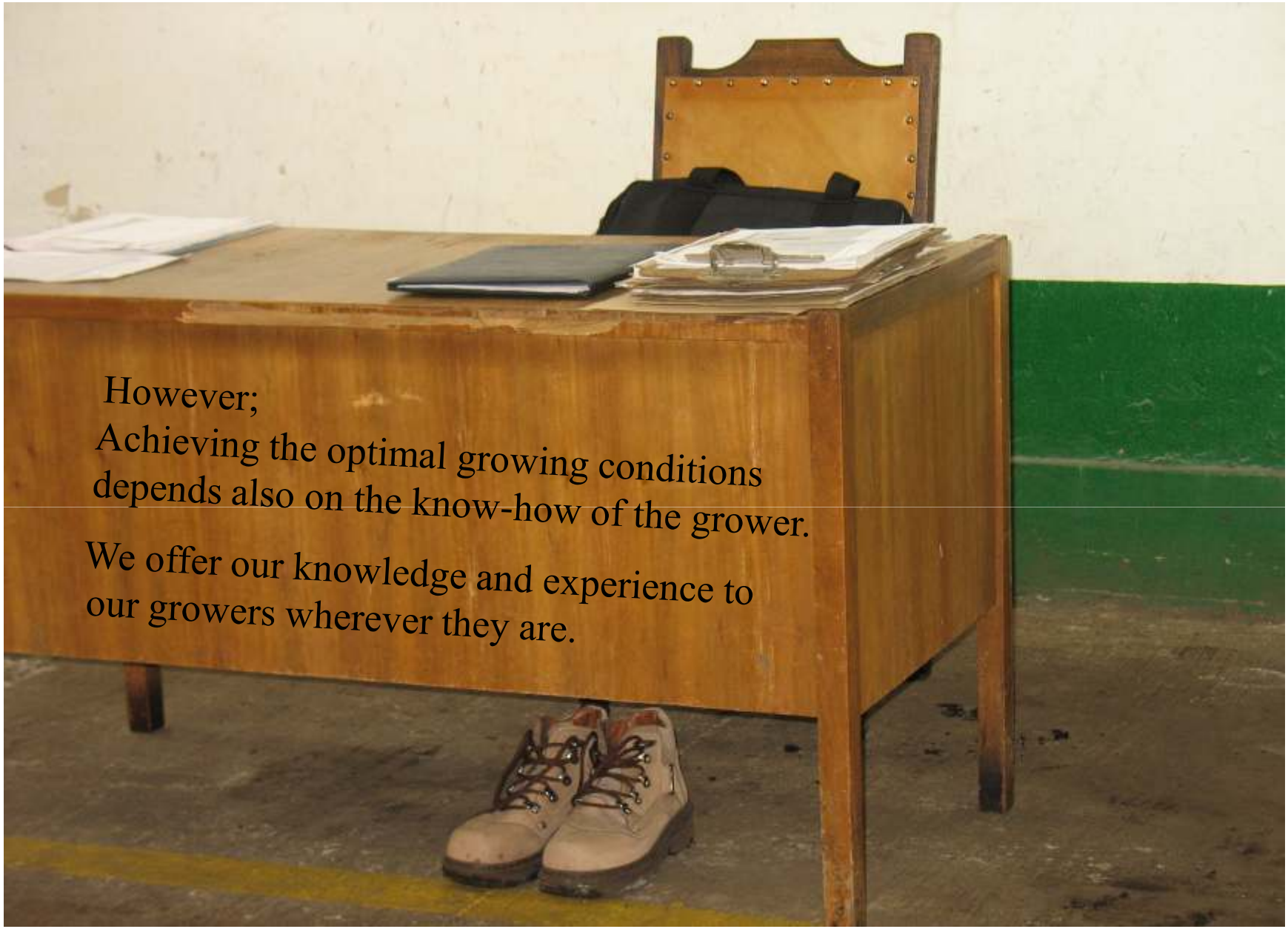
This lecture is an example for our service, aimed to share with the growers our experience - by presenting practical ways for achieving the professional steps needed for getting the maximal genetic potential of our varieties. And at the same time to study the unique character of the gerbera plant.

---

* Our varieties are marketed world-wide solely by Selecta Cut Flowers S.A.U

E-mail: info@selectacutflowers.com

For gerbera and other intensive flower crops the environment, in most of South America countries is optimal, as in this wonderful morning in the Rionegro area, Colombia.


However;
Achieving the optimal growing conditions
depends also on the know-how of the grower.
We offer our knowledge and experience to
our growers wherever they are.

Our Varieties

Rodrigo in containers (sort of Hydroponics)
4 months after planting, Colombia, March 2004


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.

A. The morphology of the gerbera

The root system -

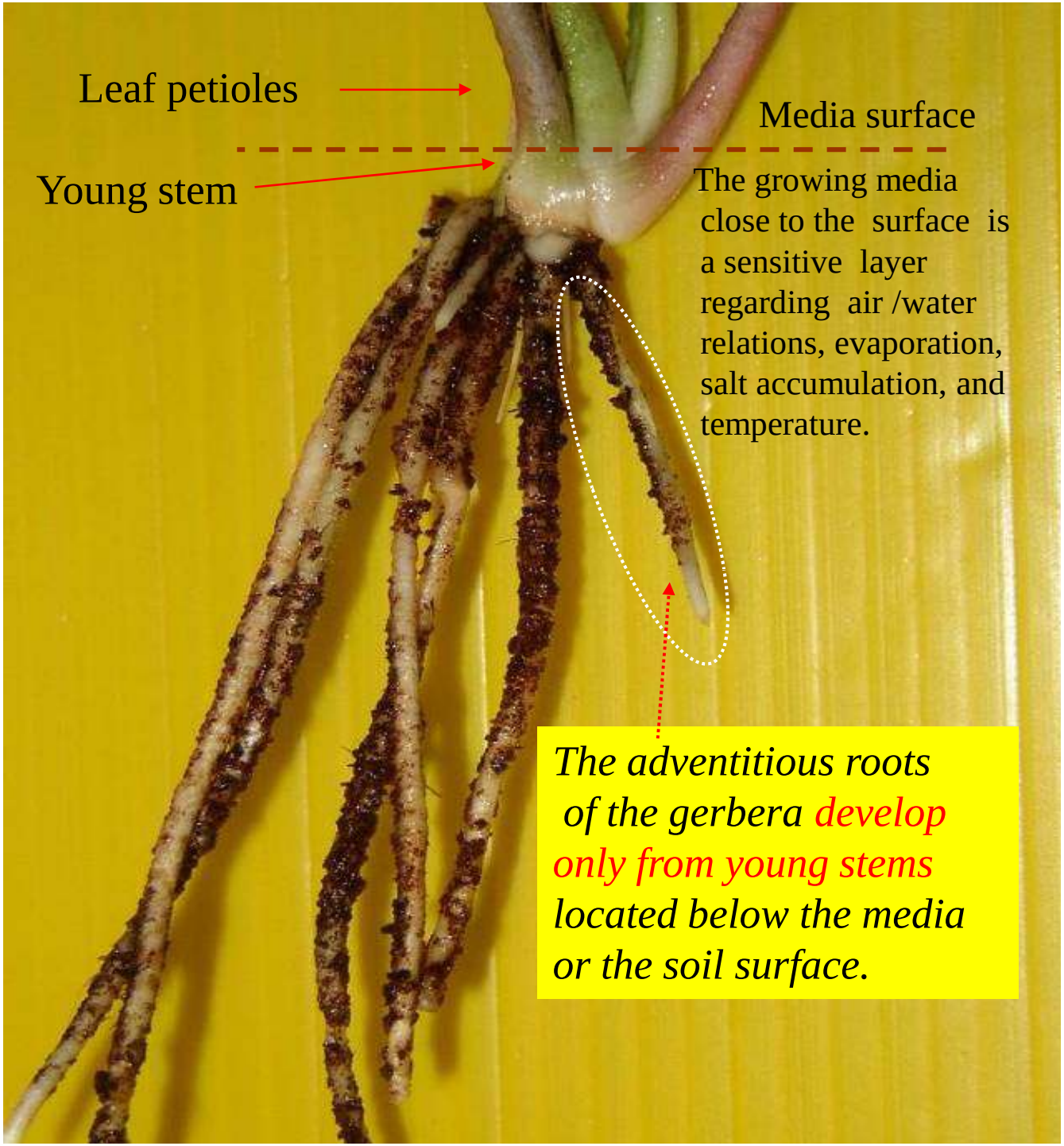
It includes: Adventitious roots, secondary roots, and root hairs

The roots are the most important organ of the plant as it absorb and supply water, oxygen and other minerals, continuously over 24 hours.

Gerbera root system in soil, Ecuador.

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

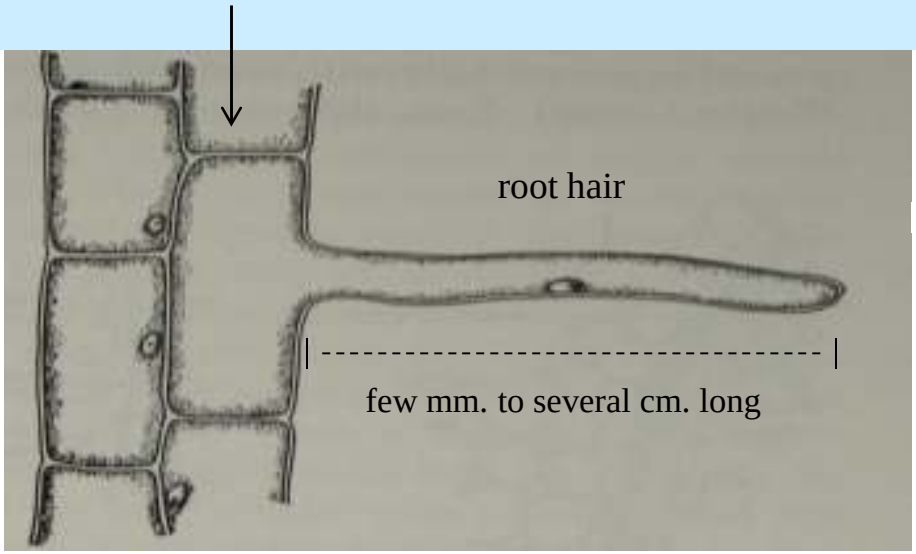
Young gerbera stem and its adventitious roots.



The root hairs

The root hairs are epidermis cells of the secondary roots.
Their function is to absorb and transport water, oxygen and minerals to the productive organs of the plants.

The epidermis:
External cells layer of the secondary roots.

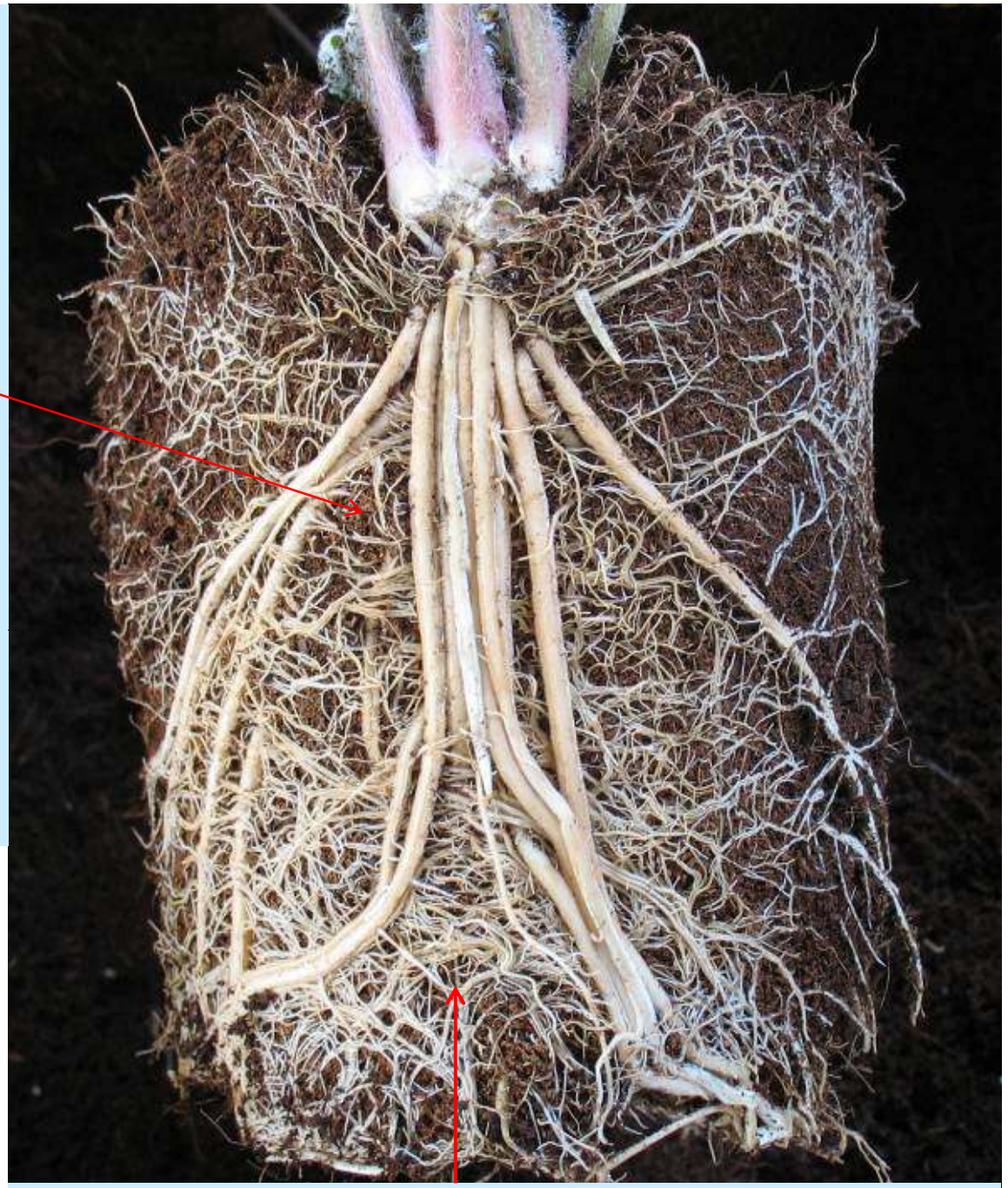


Scheme of external cell-layer of a secondary root.

Root hairs of an apple seedling

Root system of a gerbera seedling grown in coco fibers, in 4L container 100 days after planting.

Secondary roots 60 days after planting



Secondary roots grow from the adventitious roots

Absorption of water and oxygen -

Water containing oxygen and minerals is absorbed by the plant via the root hairs and the root tips.

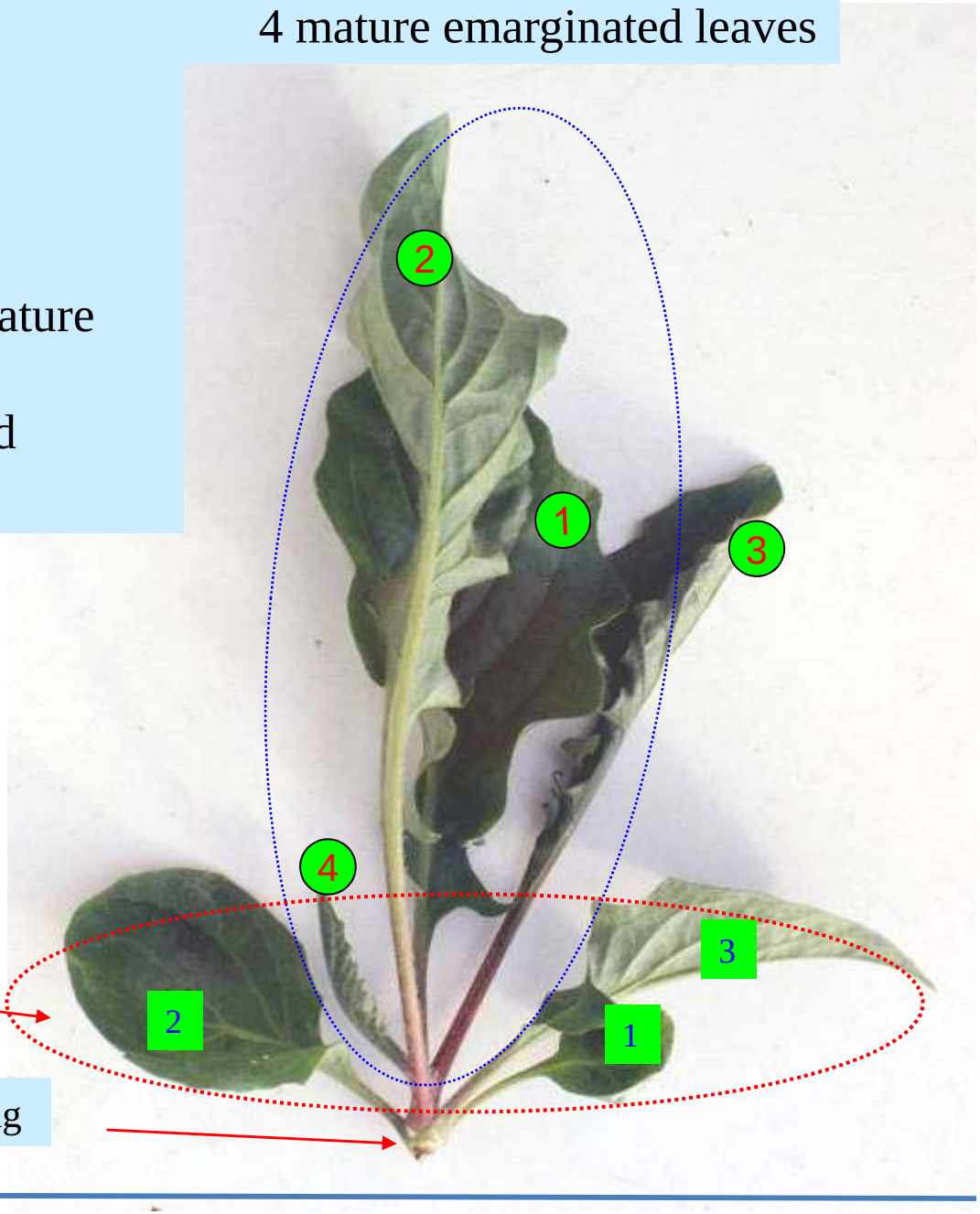
Secondary roots inside the container

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

Young gerbera plants in raised organic soil-beds (25 - 30 cm hight), Colombia.

The leaves

A gerbera stem carries only 4 mature leaves.
The mature leaves are connected to a short stem 3 to 5mm long.

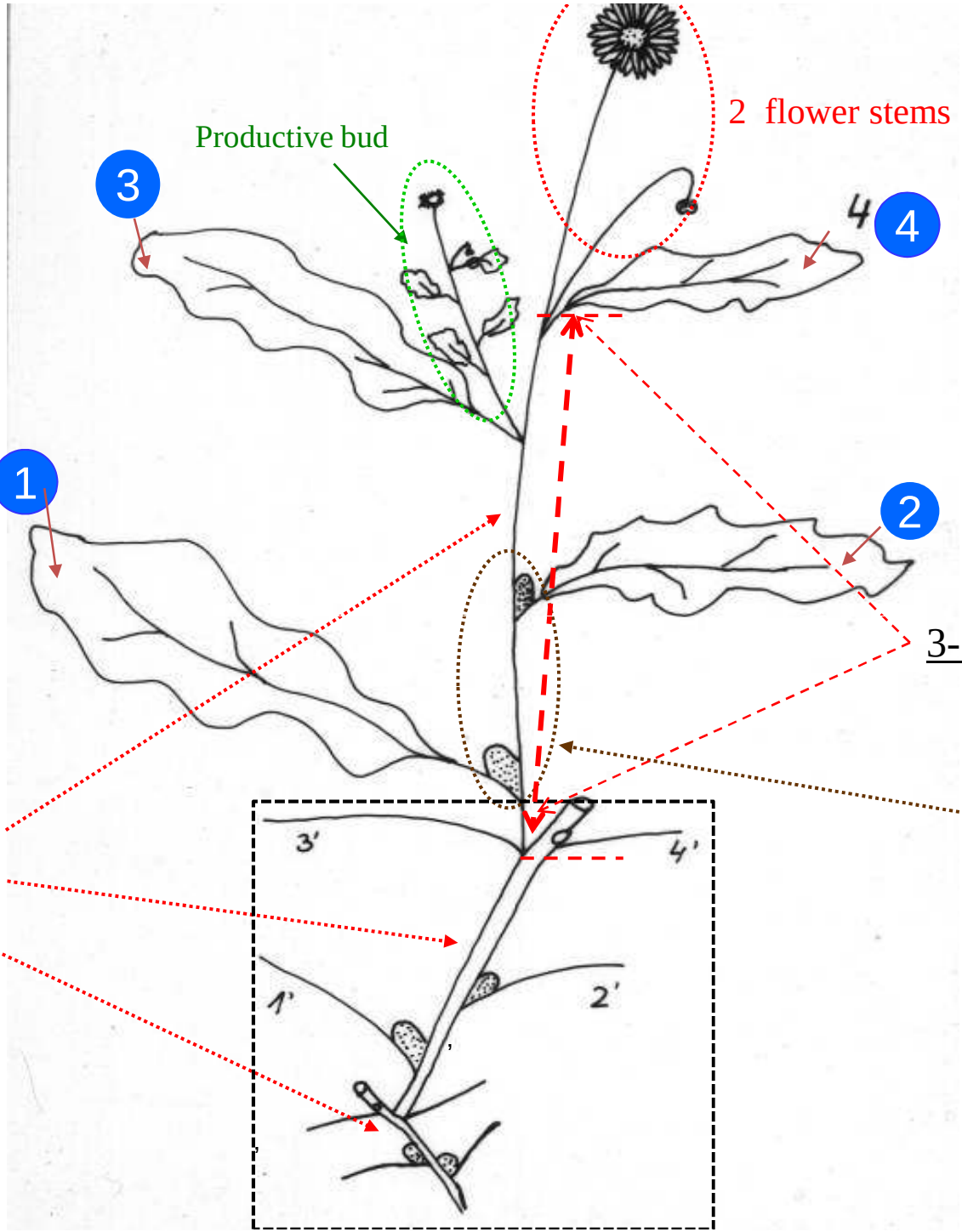


* *Round juvenile leaves are present only on Laboratory plantlets and on sprouting seedlings.*

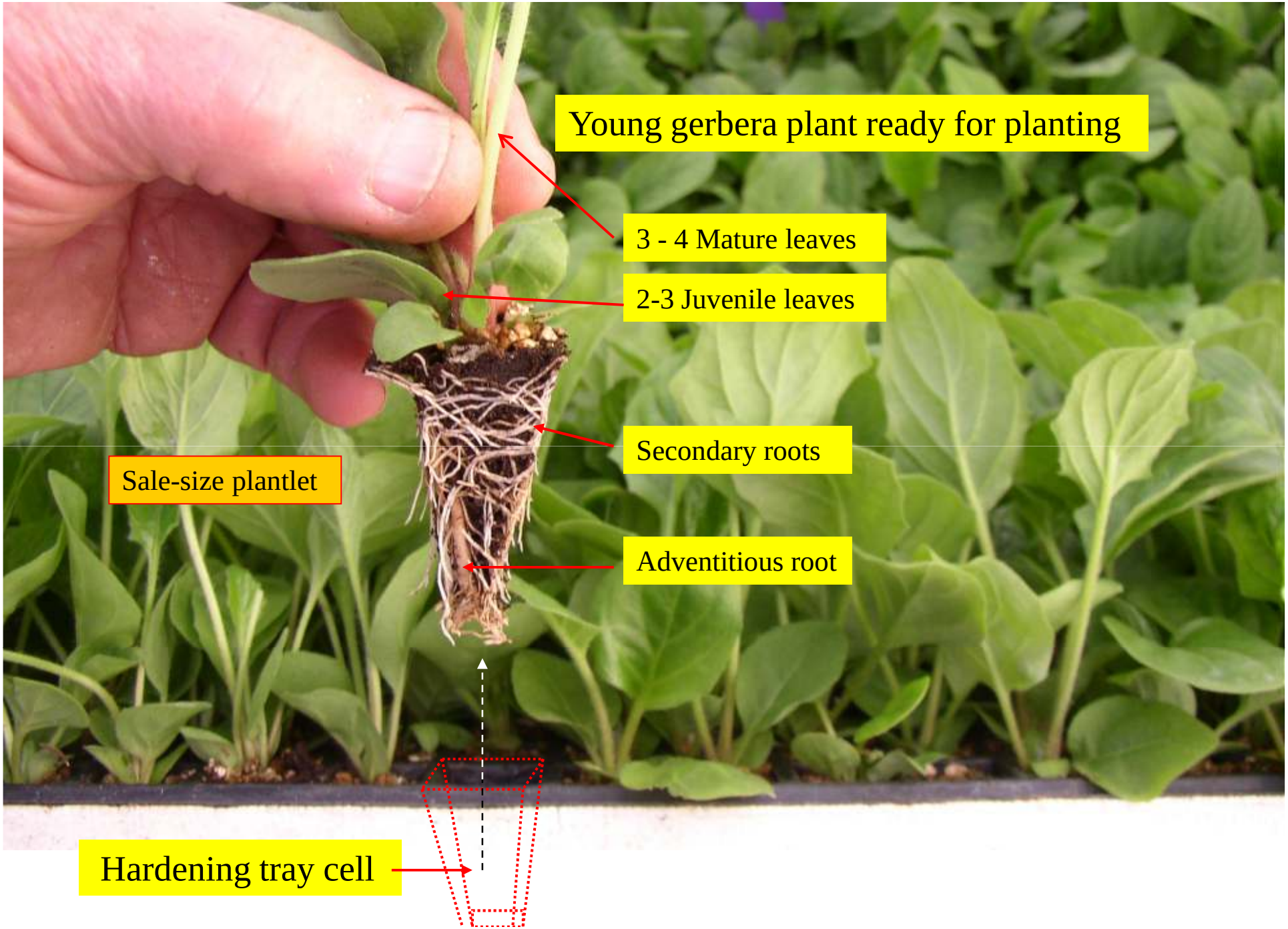
Leaves of different ages on the same plant, variety Julia


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
Sale-size plantlet
Adventitious root
Hardening tray cell

Growth & development

The gerbera is a
‘self inductive plant’.

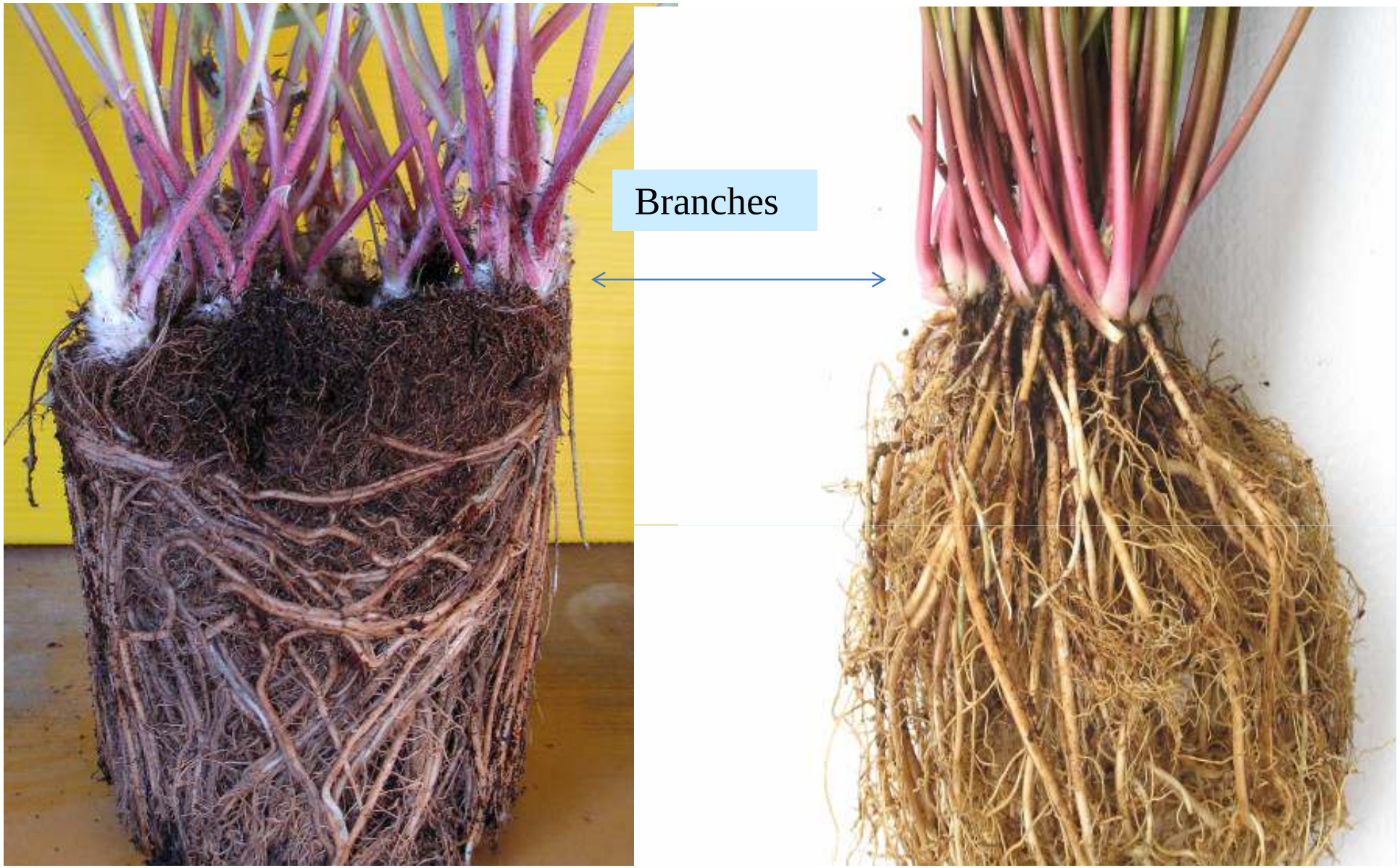
Blooming is not affected by day length or temperature.

It affected and related only to

the growth rate.

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


10 weeks after planting
gerbera 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

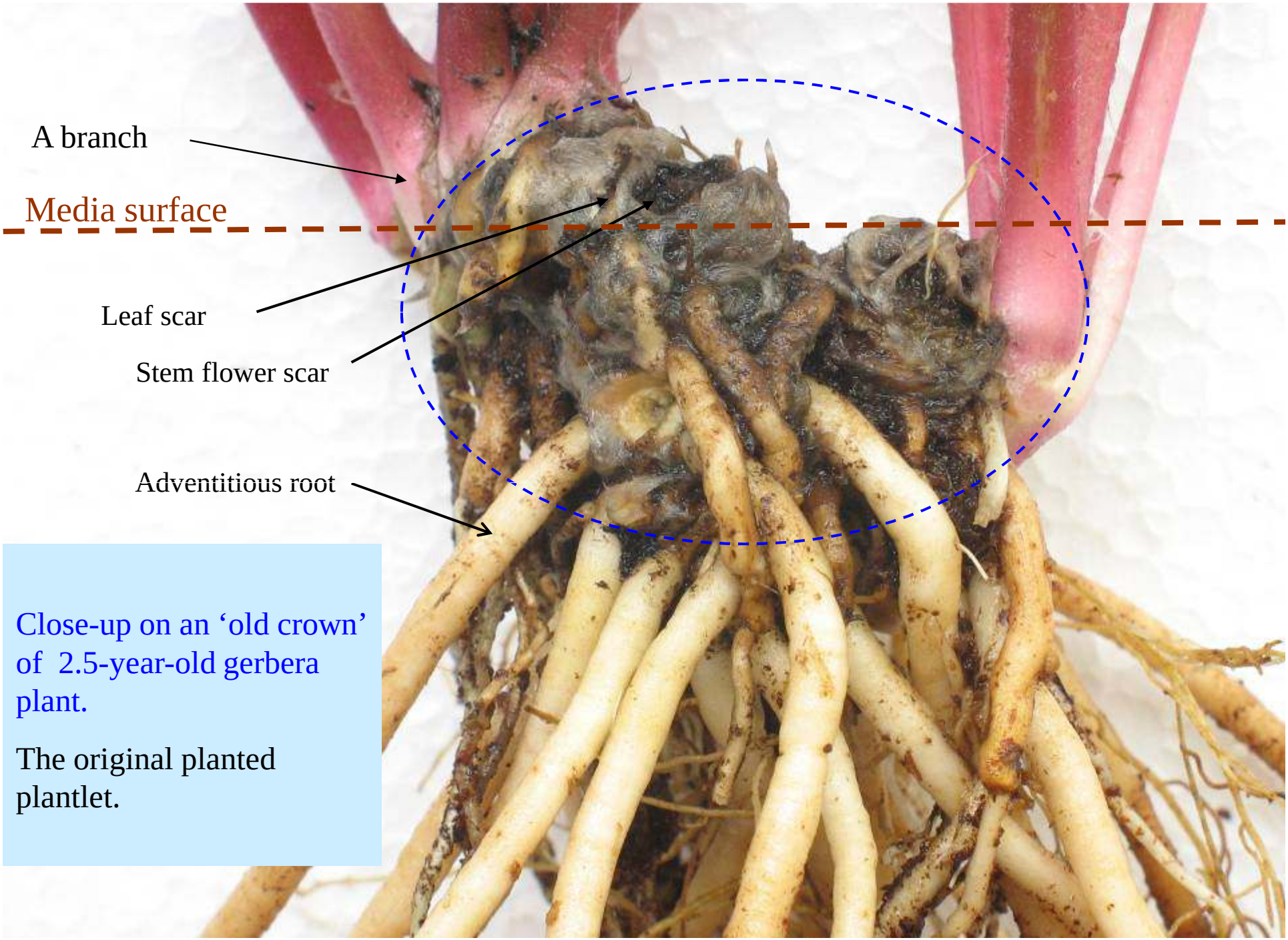
The gerbera crown
is composed of crowded,
compressed branches.

Adventitious root

Secondary roots

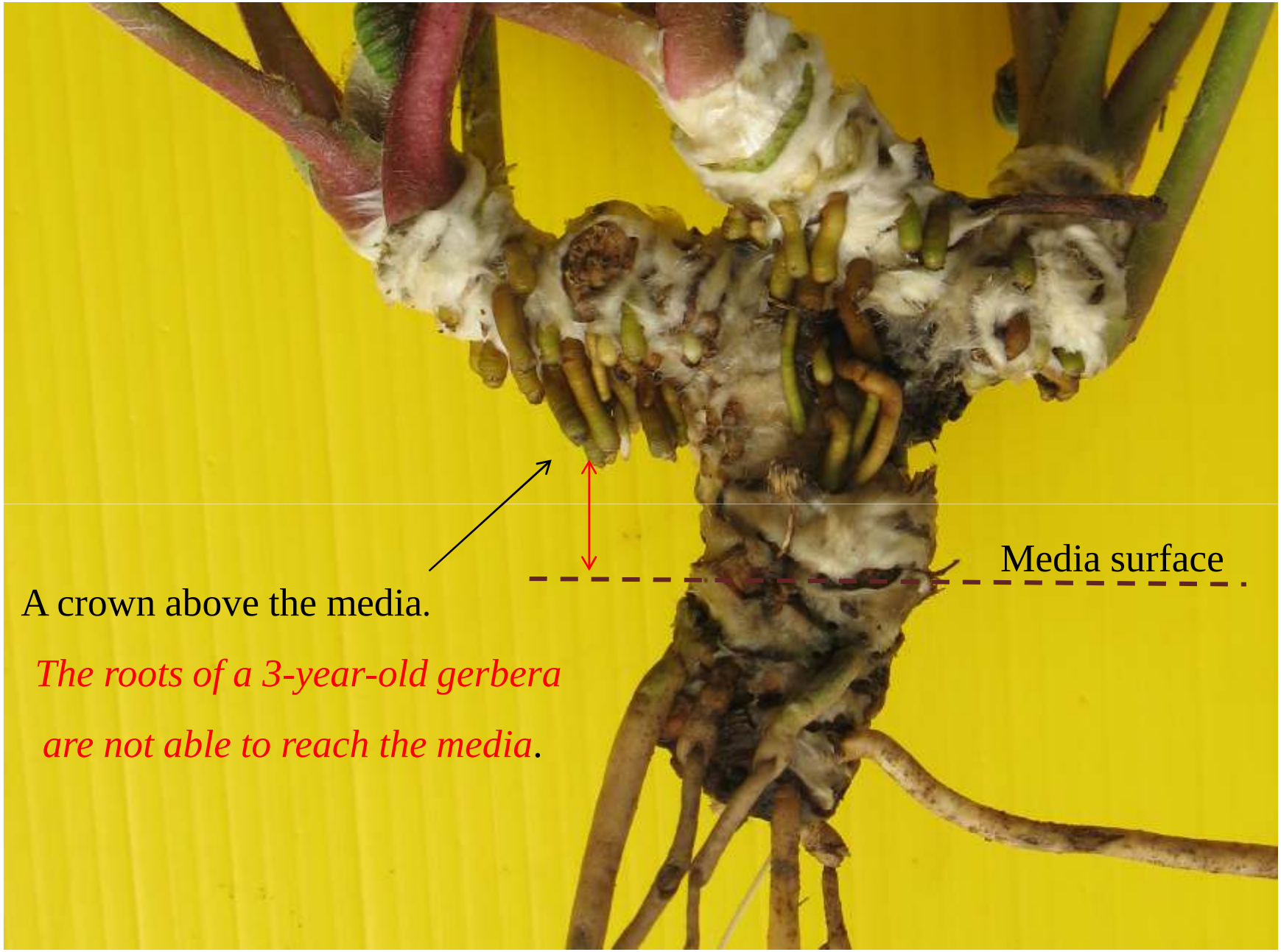
Young crown

A compressed branch
without its leaves



Close-up on an ‘old crown’ of 2.5-year-old gerbera plant.

The original planted plantlet.


Media surface
A crown above the media.
The roots of a 3-year-old gerbera
are not able to reach the media.

An ‘old’ split-up gerbera plant, Colombia.

The Inflorescence =

The ‘Flower’

Gerbera jamesonii

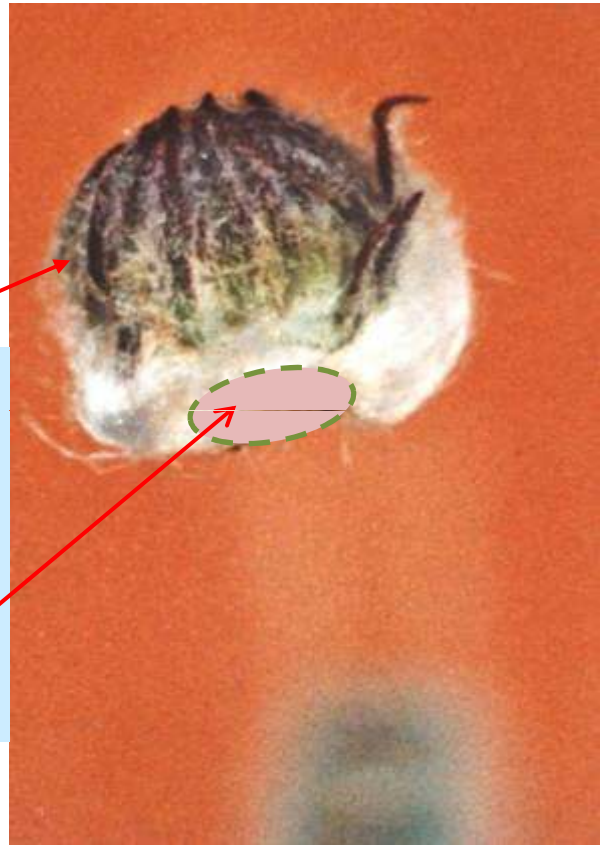
The gerbera originates in Barberton, Transvaal, South Africa.

Gerbera jamesonii in nature -
Barberton, South Africa August 2006

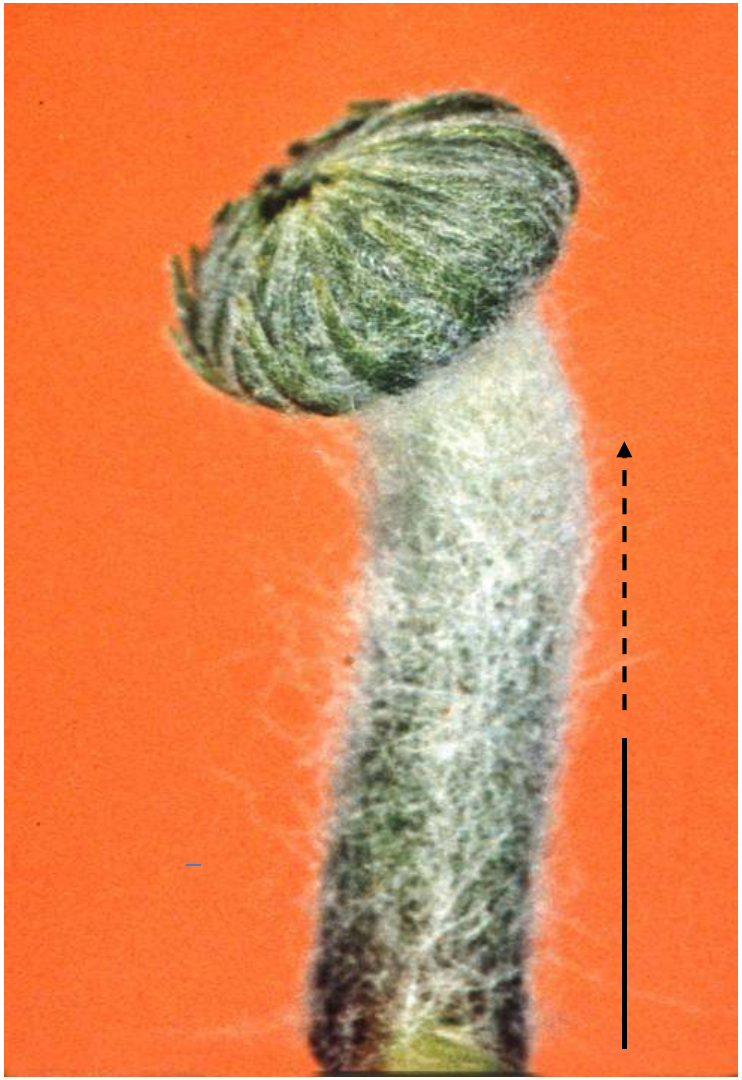
The flower bud and the flower stem

Flower bud (5-7 mm),
as first seen between the leaves.

At this phase the stem is not visible.



Stem elongation

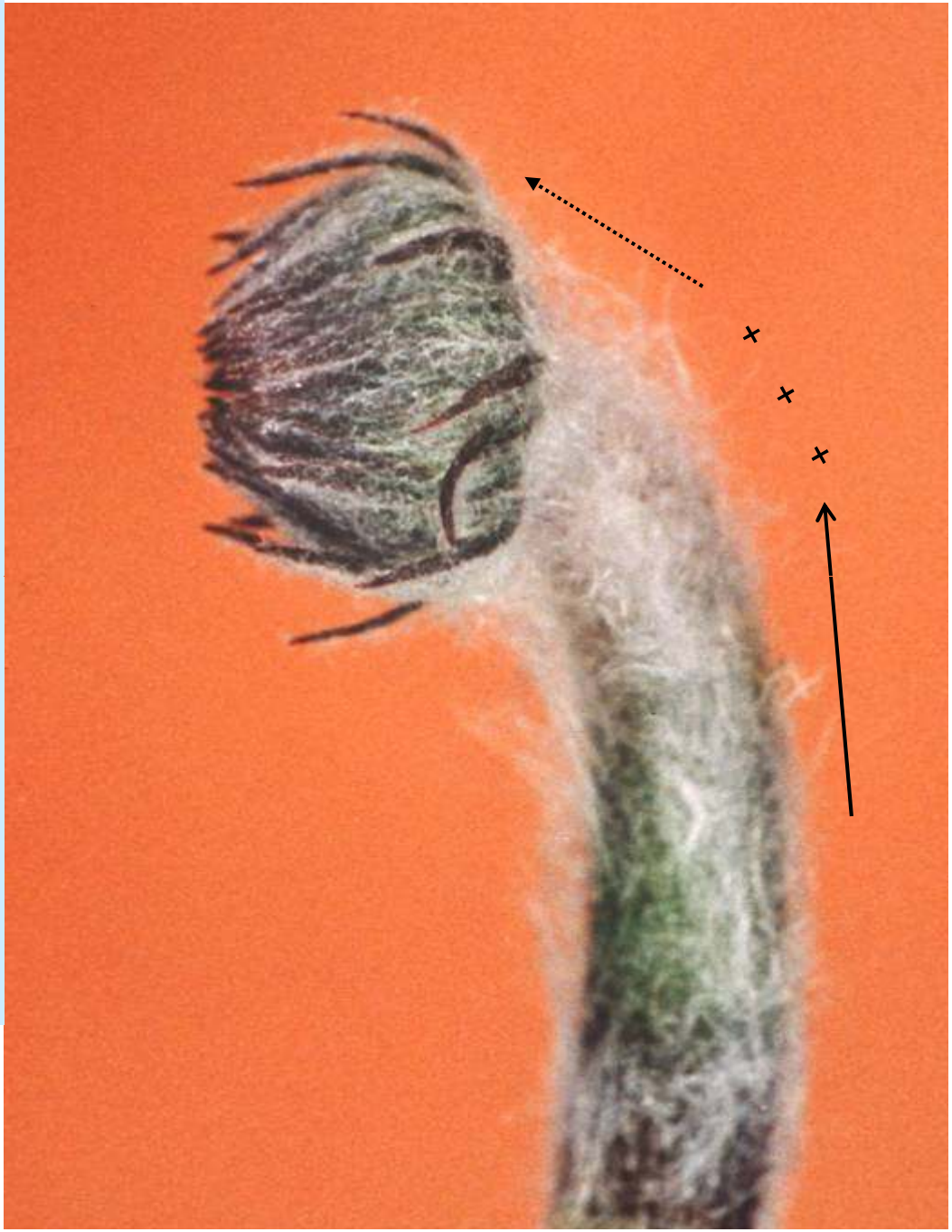


The elongation starts from the base of the stem.

The elongation process is not symmetric.

One side grows and elongates faster than the other side.

This growth pattern directs the flower-head downwards.



Flower-head among the leaves.

As long as the flower-head is located among the leaves, the stem continues to grow in a non-symmetric pattern.

This kind of growth protects the flower-head physically until it passes the leaves.

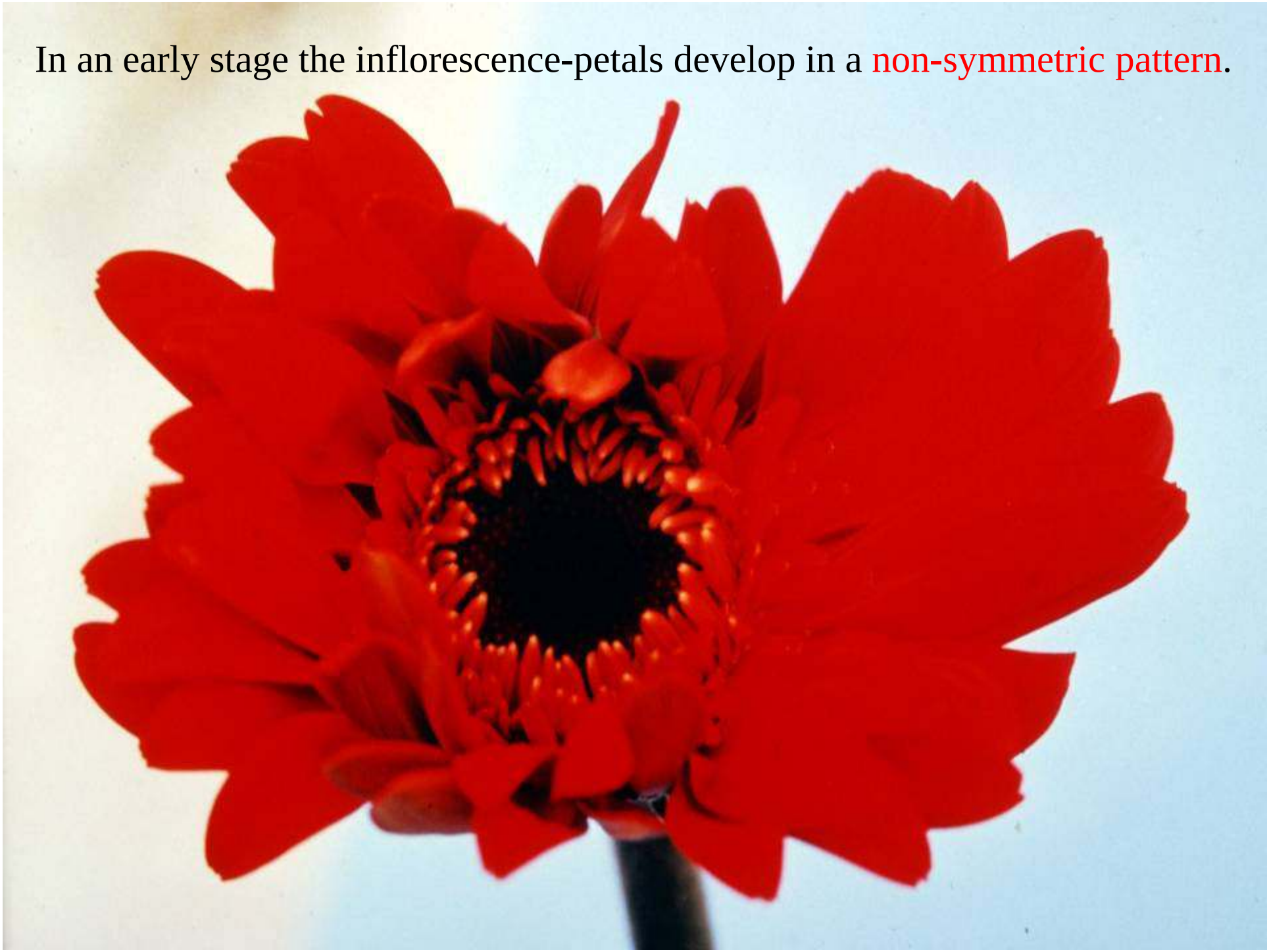
Later on, the direction of growth turns and the stem with the flower-head straightens upwards.

Stem and flower-head among the leaves.

A flower-head that has just passed the boundary of the leaves.

Thus, the higher the leaves, the longer the stem.

In an early stage the inflorescence-petals develop in a non-symmetric pattern.

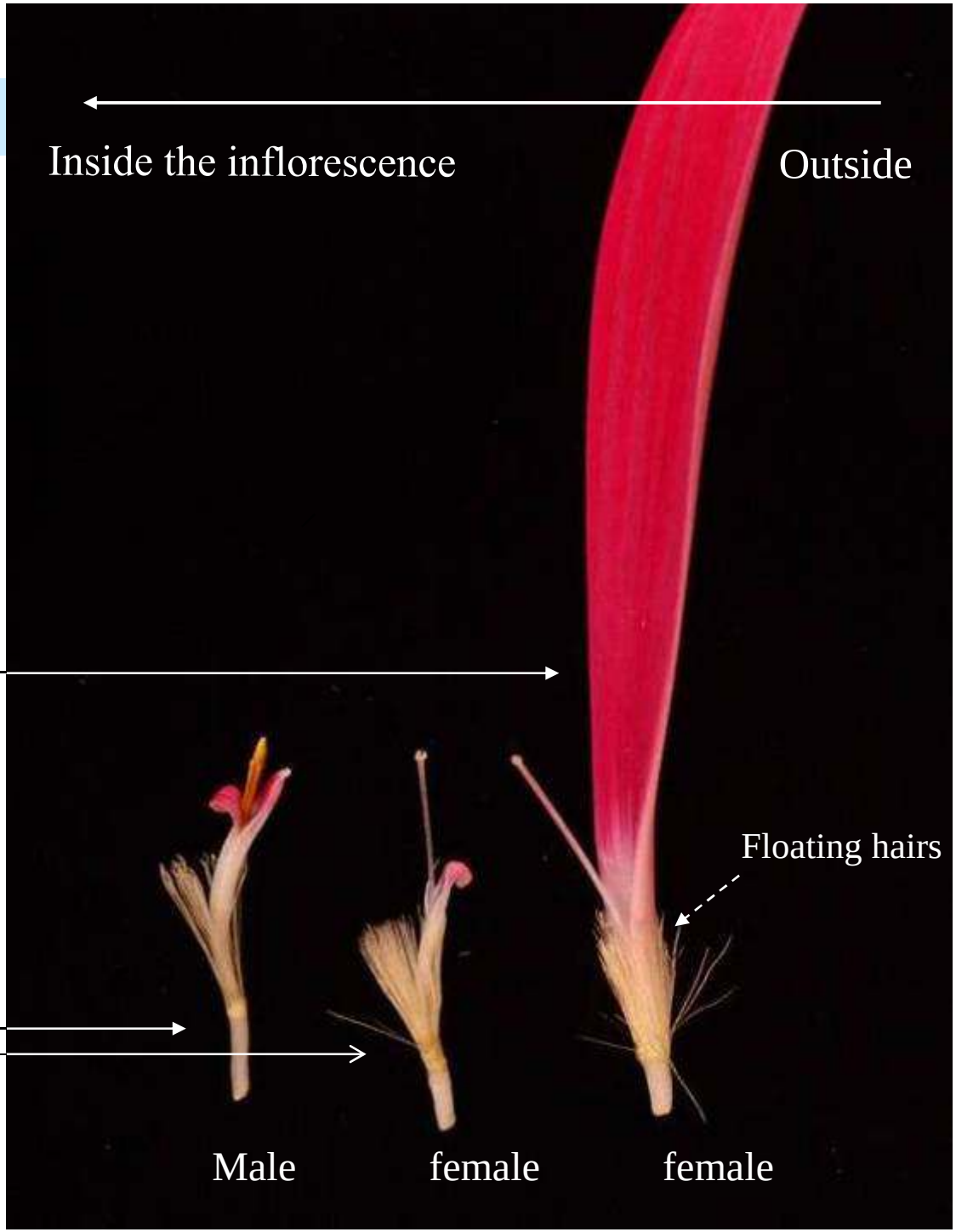


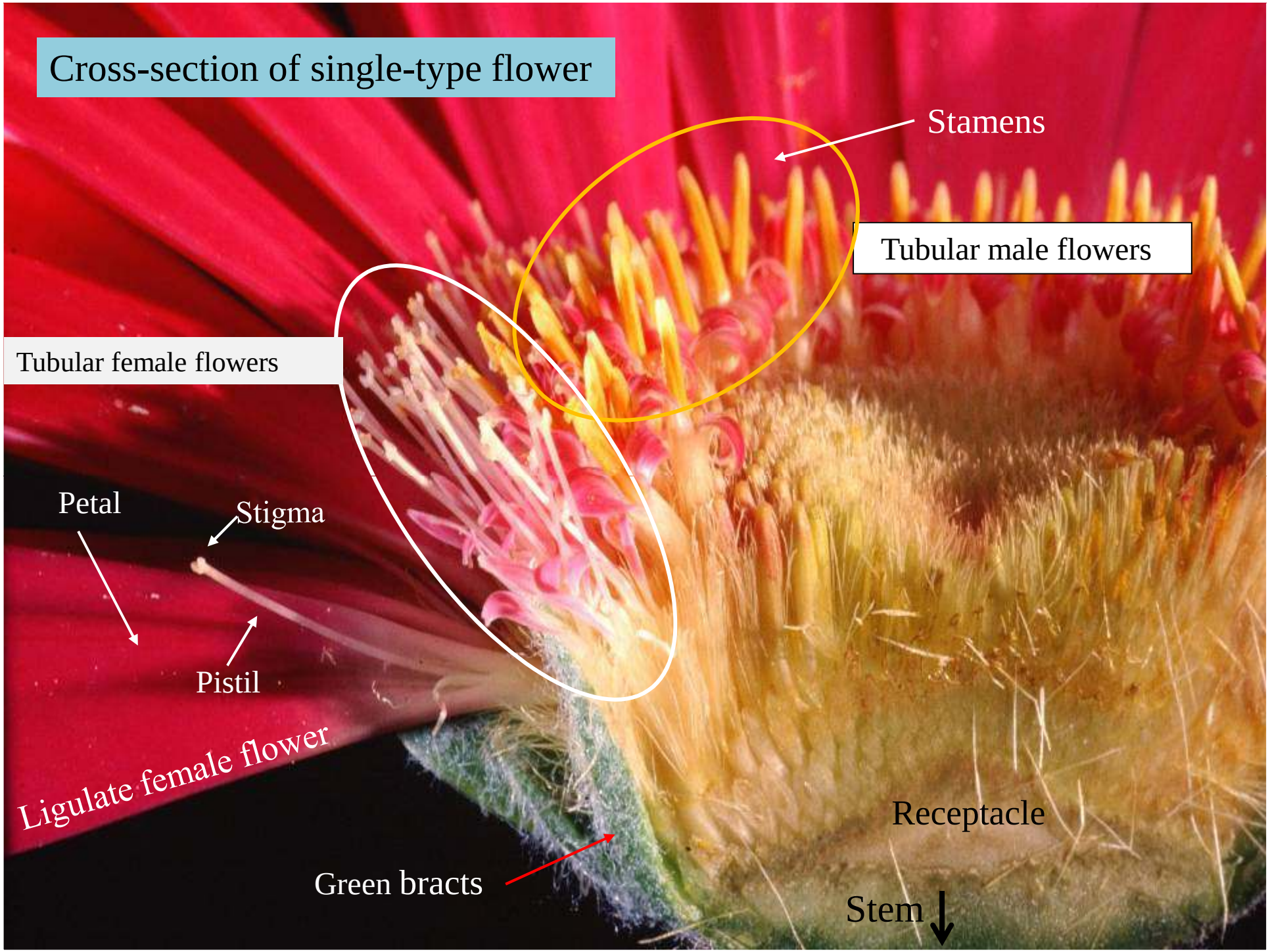

In the mature stage, the inflorescence turn out to be symmetric.
Lorca - Semi double-type flower

Single-type flowers

Ligulate flower

Tubular flowers

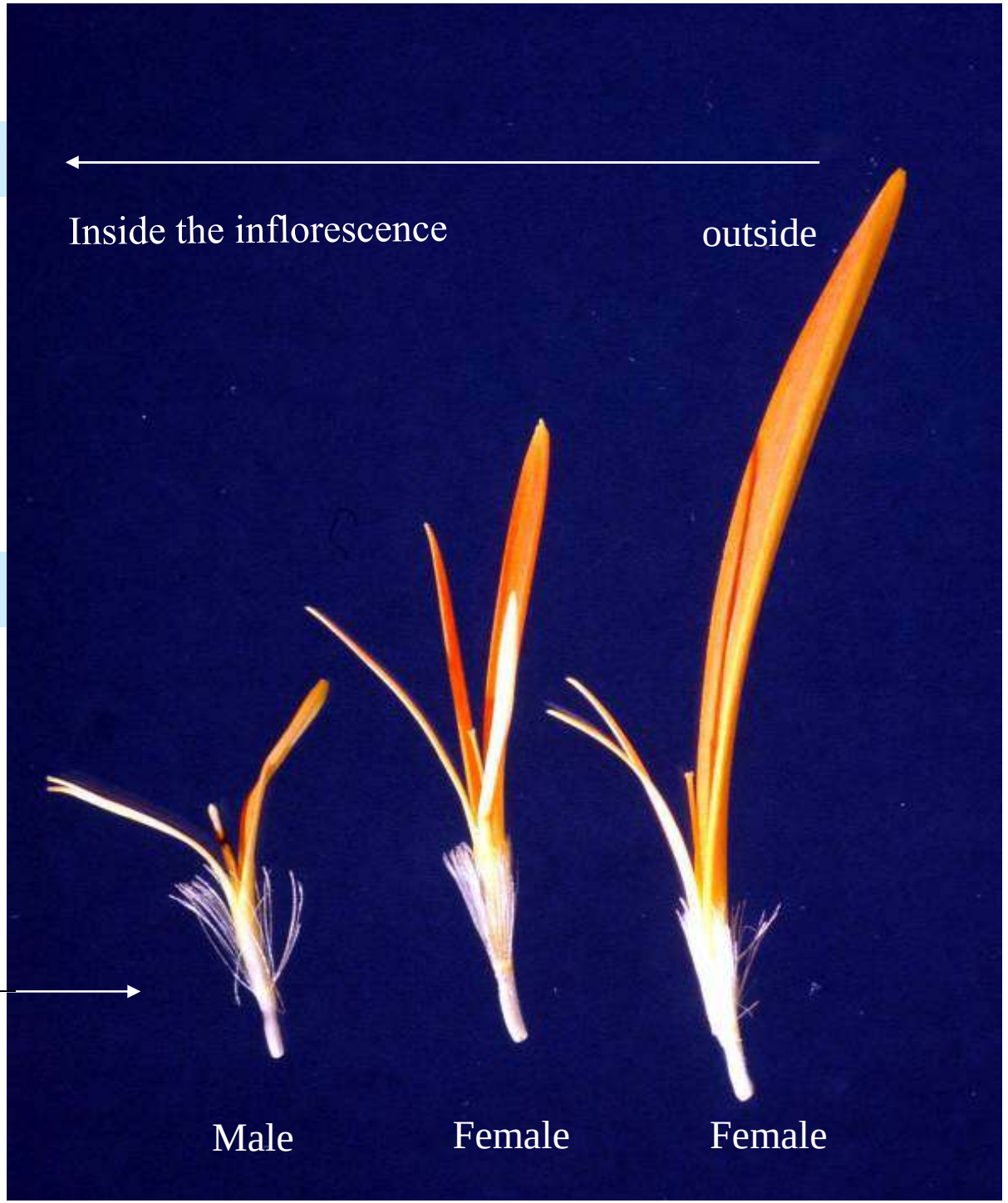



Cross-section of single-type flower
Stamens
Tubular male flowers
Tubular female flowers
Petal
Stigma
Pistil
Ligulate female flower
Receptacle
Green bracts
Stem

Double-type flower

Semi-double flower

Ligulate flowers



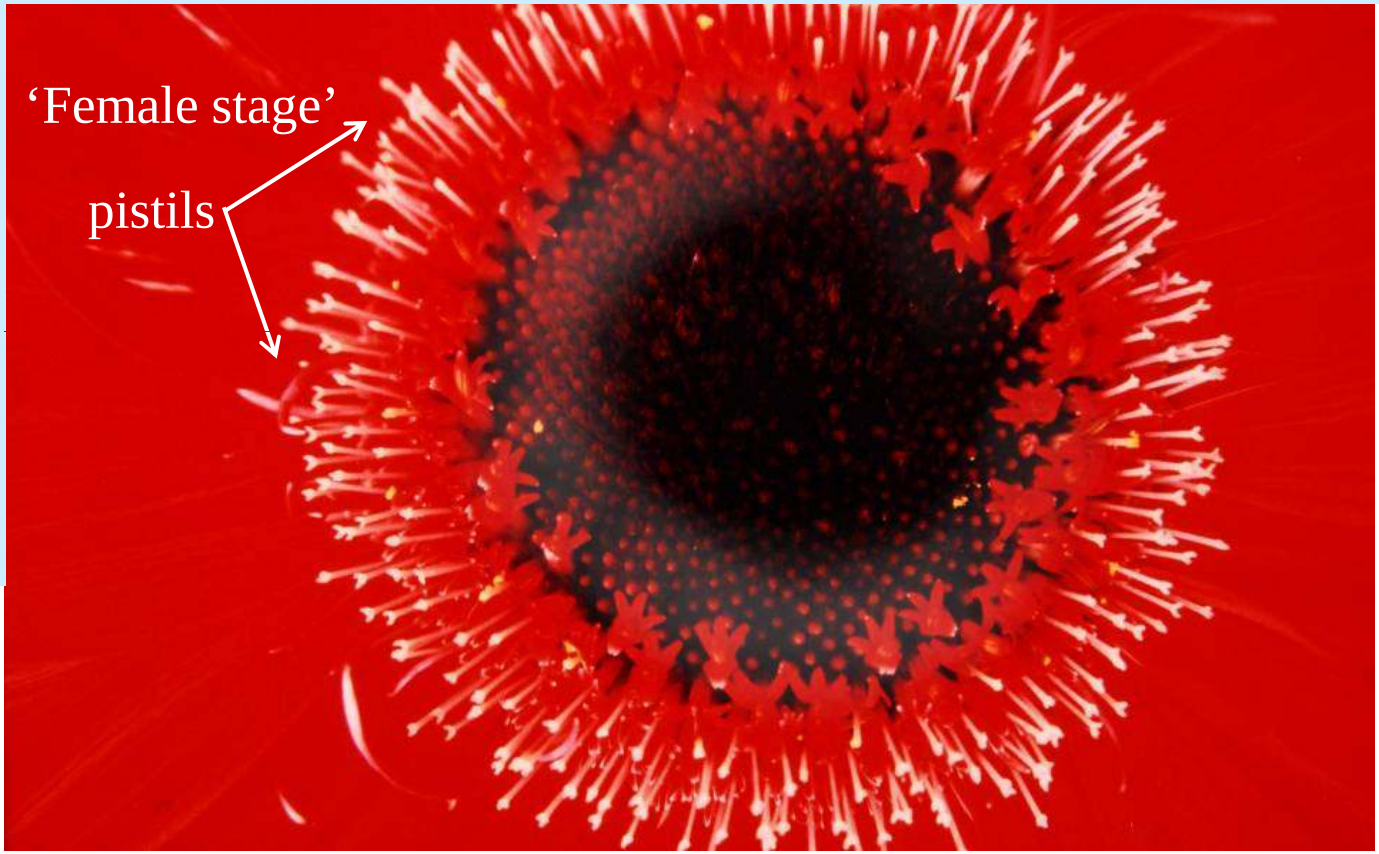
‘Female stage’ of a single-type gerbera -

Only pistils are seen, the stamens are not visible yet.

At this stage the flower-stem is still young and is not ready for harvest.

As a general rule - the flower-stem is ready for harvest, only when 2 circles of male flowers are fully developed.

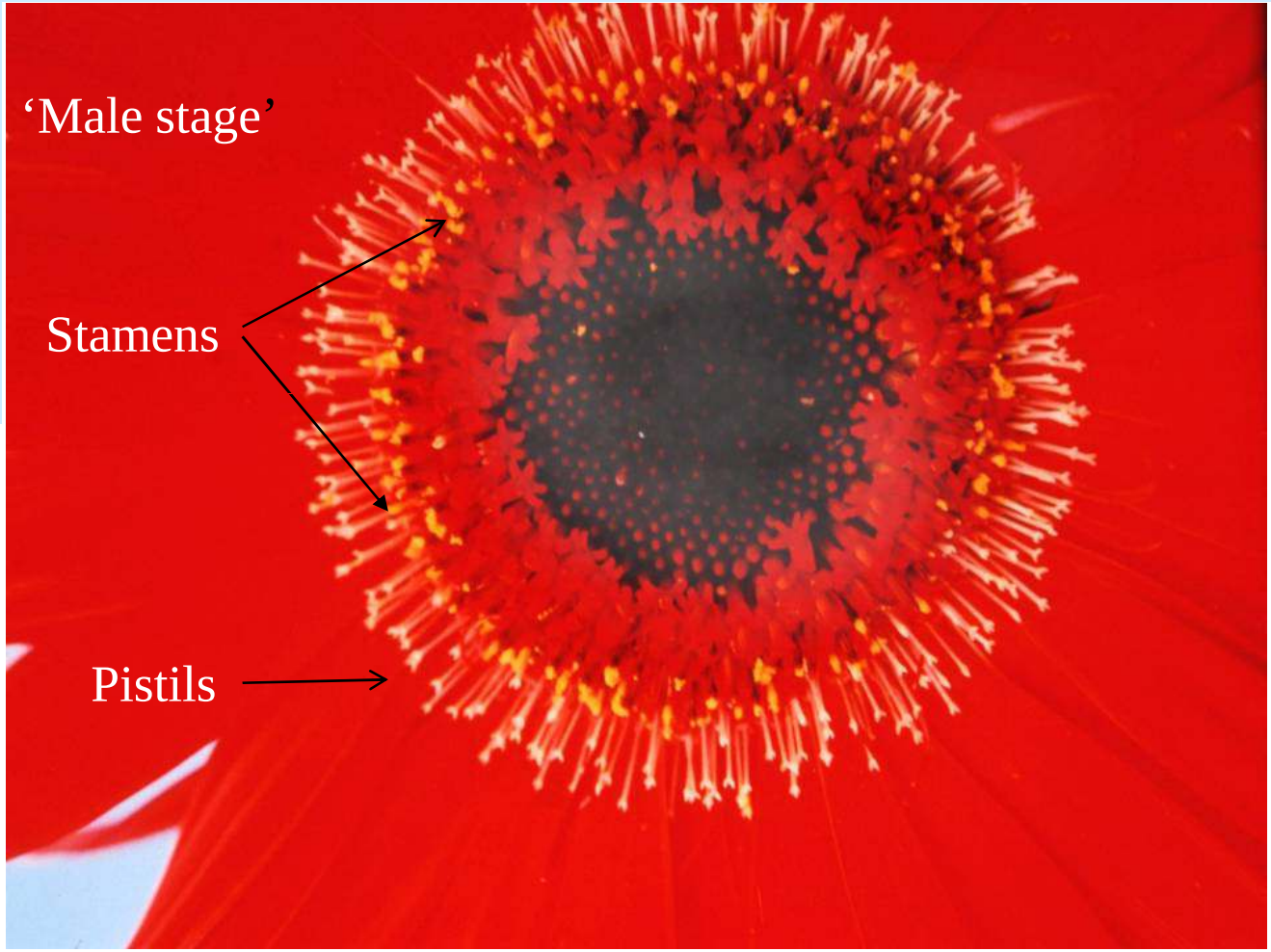
See next slide



→ *The same single-type flower 2 days later .*

As a general rule -
When 2 circles of male flowers with stamens are seen, the Flower-stem is ready for harvest.

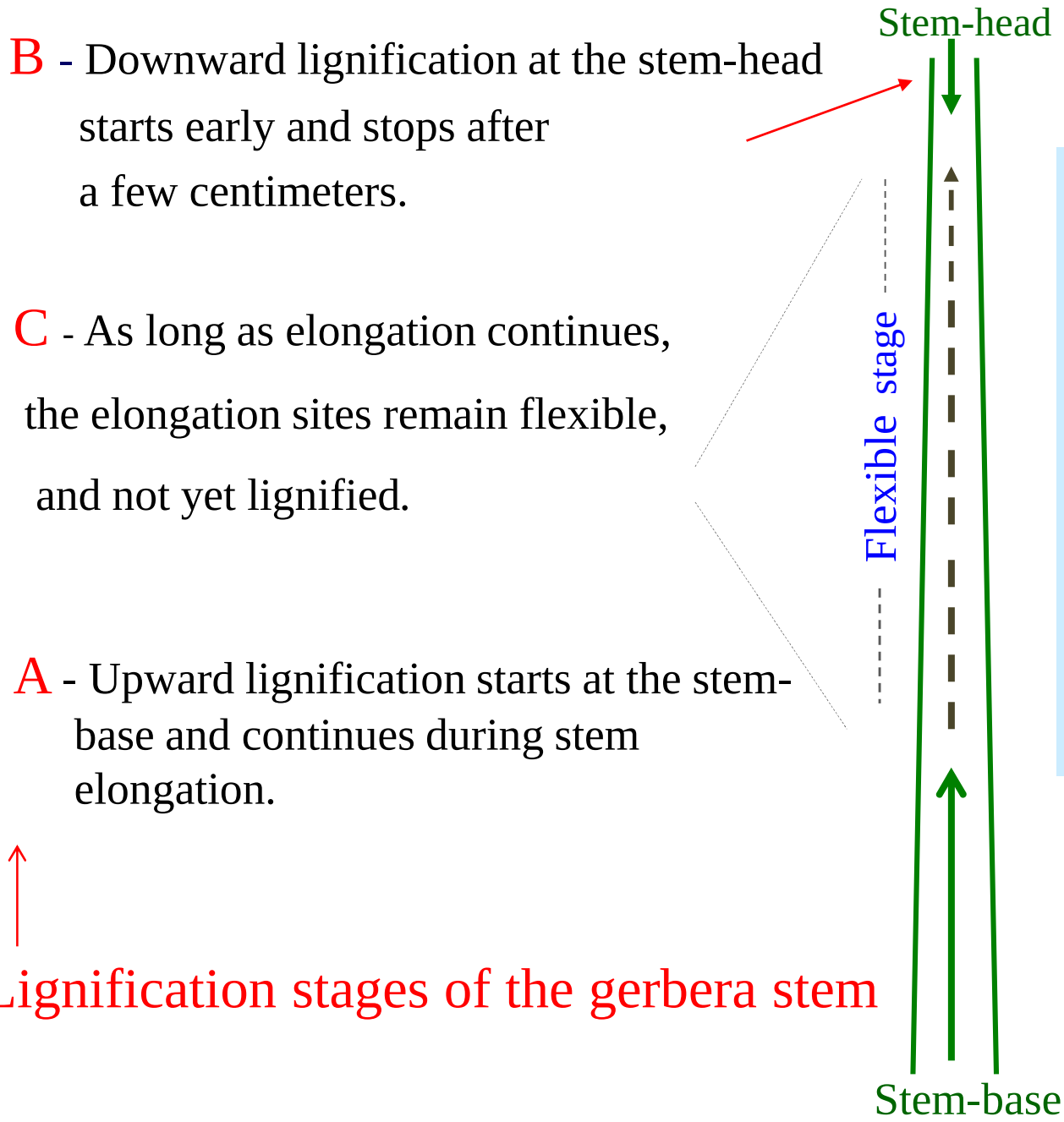
The ‘Male stage’ of a single-type gerbera -
At this stage the yellow stamen are seen .



B - Downward lignification at the stem-head starts early and stops after a few centimeters.

C - As long as elongation continues, the elongation sites remain flexible, and not yet lignified.

A - Upward lignification starts at the stem-base and continues during stem elongation.



Lignification stages of the gerbera stem

Best time for harvest the gerbera stems:

Never harvest gerbera stem during the flexible stage ! !

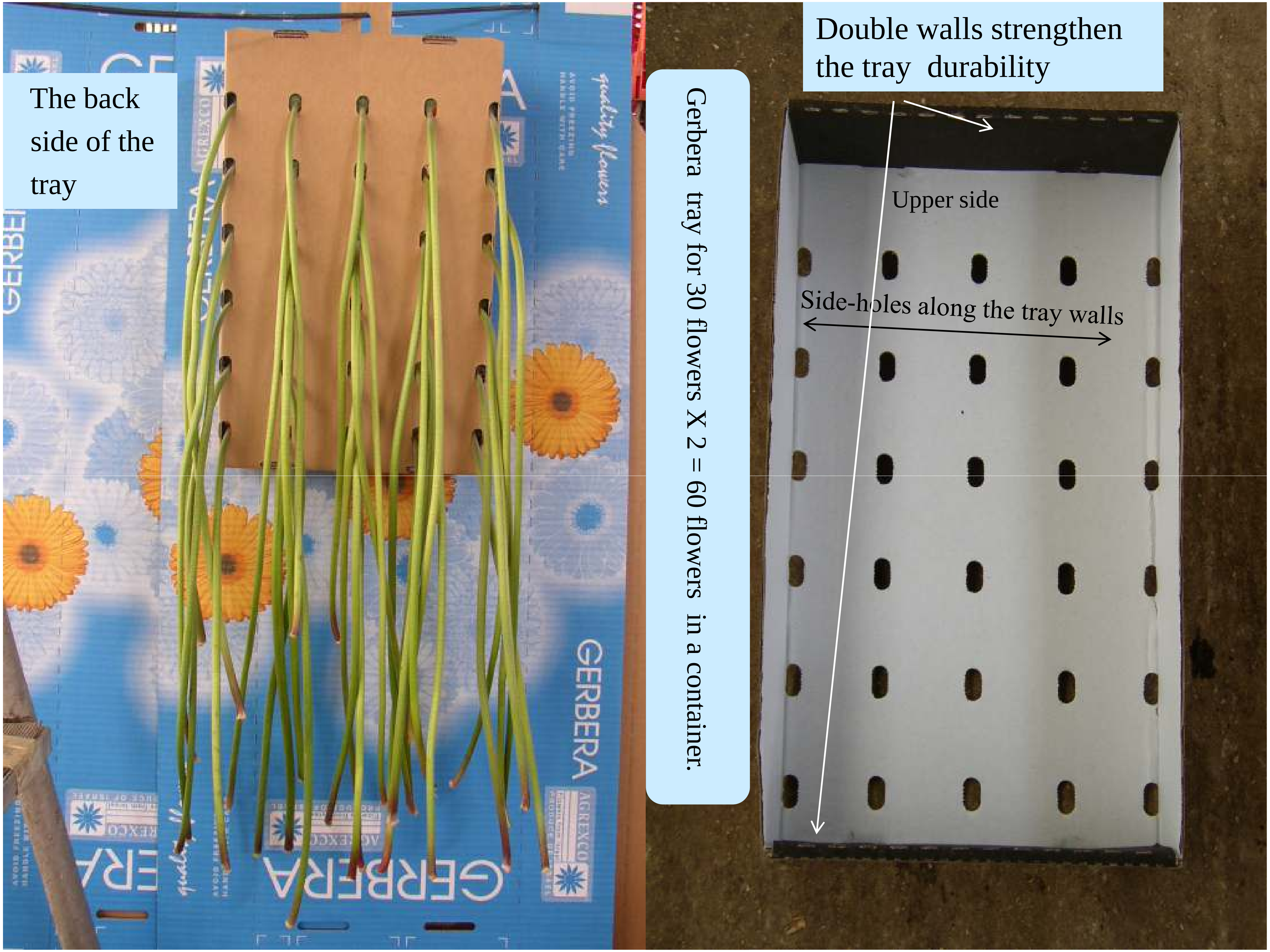
*The **vase-life** of the stem is assured. Only when most of the stem is lignified*

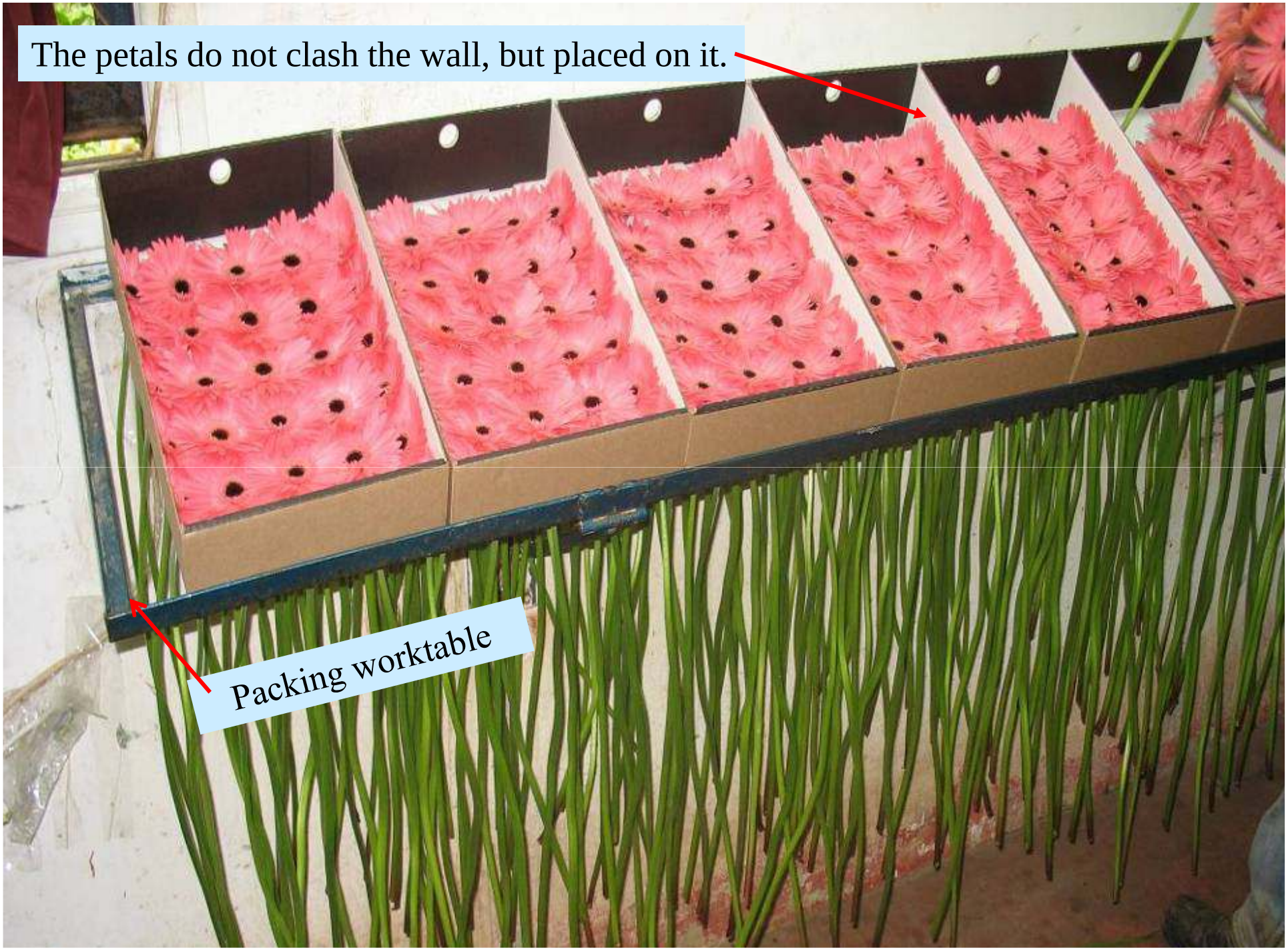
Post-harvest treatment -

Loading the stems with bleaching compound

(Sodium hypochlorite 2-3 cc / Liter).

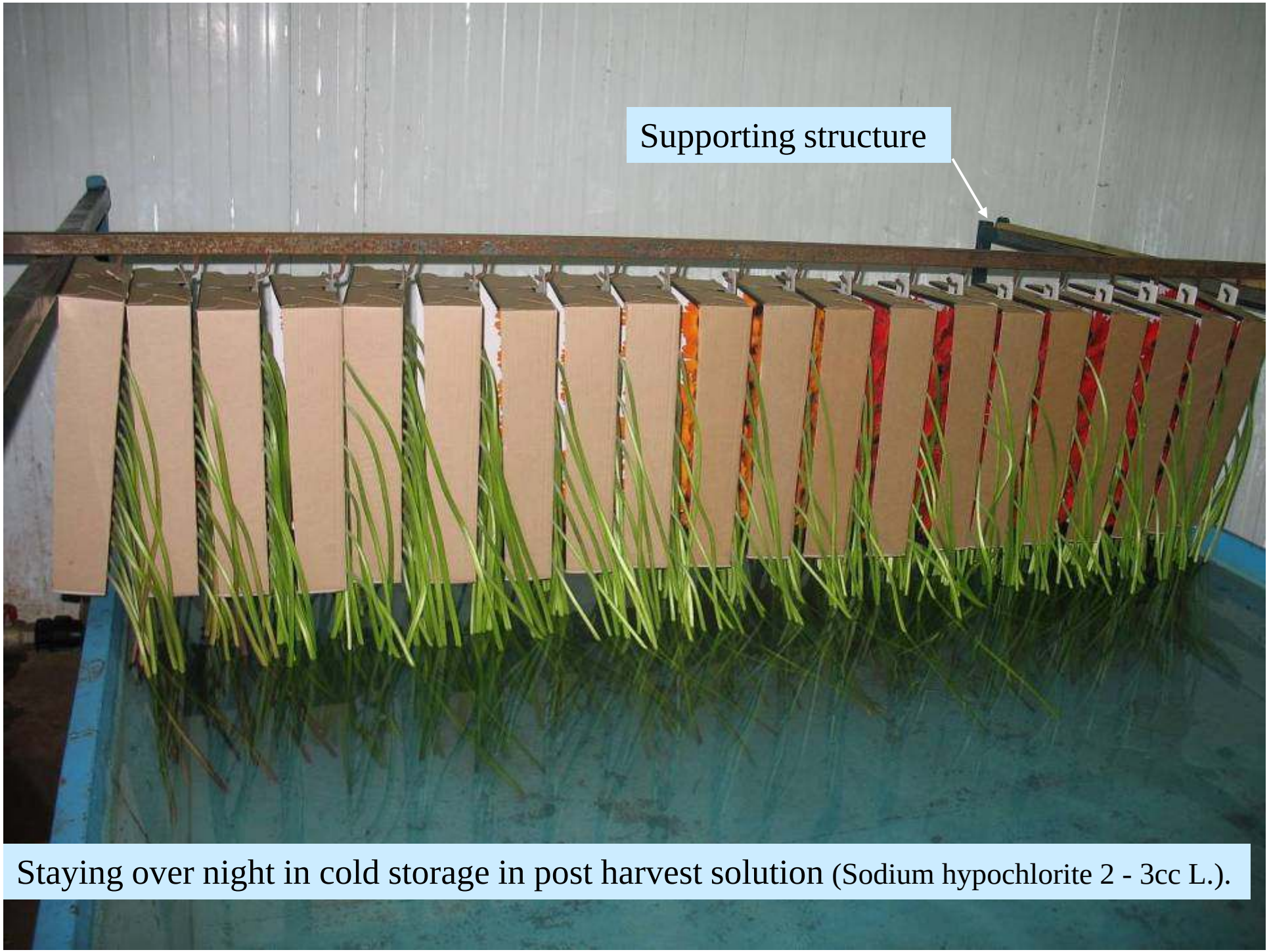
Our varieties in soil - Ecuador


The back side of the tray
Gerbera tray for 30 flowers X 2 = 60 flowers in a container.
Double walls strengthen the tray durability
Upper side
Side-holes along the tray walls
GERBERA


The petals do not clash the wall, but placed on it.
Packing worktable

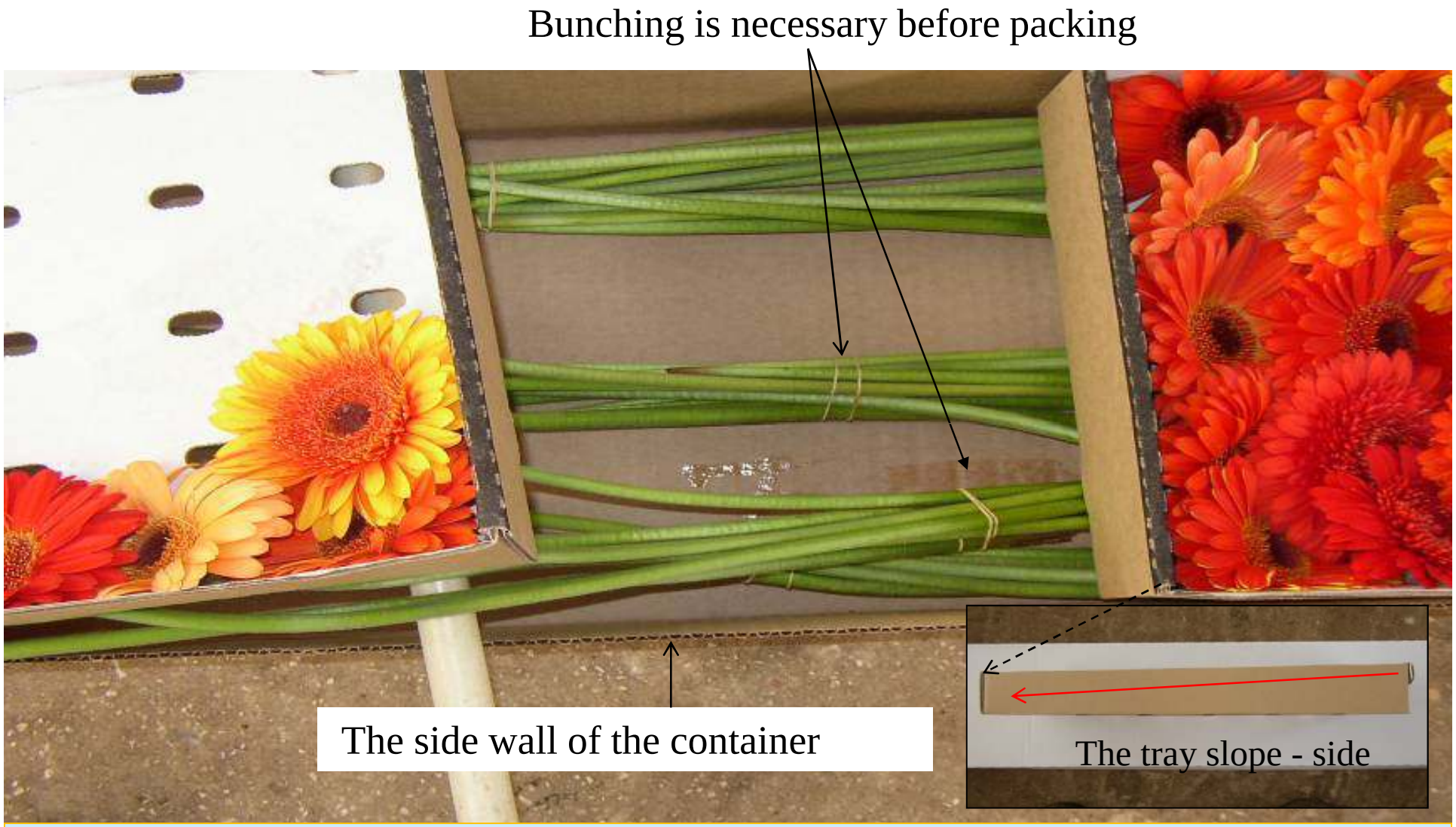

Too long stems are cut


Packed trays are hanged on a metal pole



Staying over night in cold storage in post harvest solution (Sodium hypochlorite 2 - 3cc L.).

Packing - Bunches of one tray, are laid beneath the second tray.



On arrival at the customer store - Cut the stems bases in water, and move it immediately to post harvest solution.


The end
of lecture 1

Gerbera -

Practice & Theory

Selected chapters

B. Salinity

C. Fertigation & salinity

Second lecture

D. Growing conditions

Dr. Yoseph Shoub

Gerbera Breeding Ltd. Israel

B. SALINITY

Salinity is the enemy of intensive agricultural crops, a situation caused by modern agriculture.

The fact is that intensive agricultural crops absorb and store only 5 -10% of the minerals, normally supplied by modern agricultural methods.

The unused excessed minerals in the growing media, and some irrigation programs create the Salinity Problems.

Severe damage to gerbera flowers caused by salinity in containers

What is Salinity

Salinity is accumulation of excess salts:

> In the growing media (soil or any other media),

> in the soil solution,

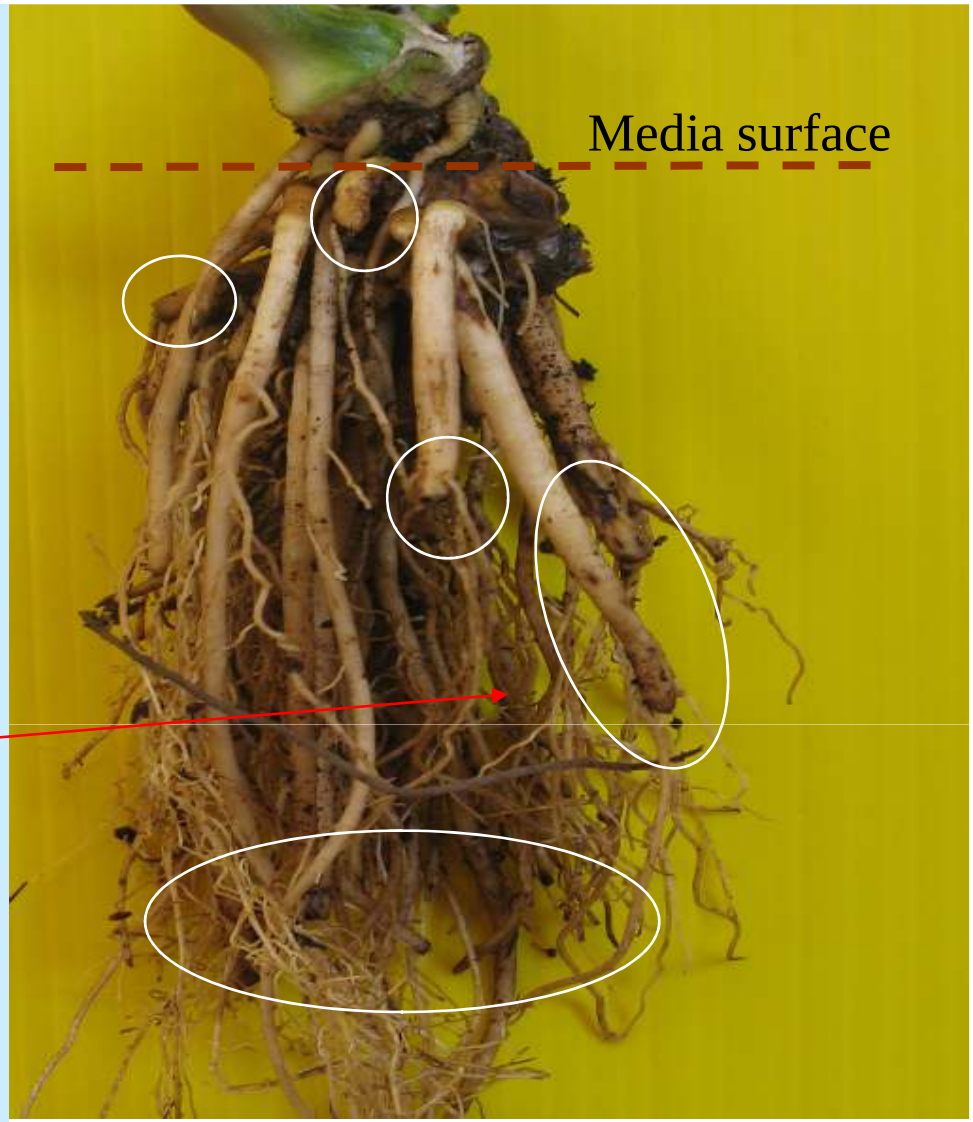
> and in the plant organs.

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 root system (root burn).

Continues with damage to the above-soil organs, and ends in reducing the production and the quality of the produce.

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.



Root burn - Salinity damage in gerbera

India, June 2009

In the soil beds volume.

Mexico, February 2008

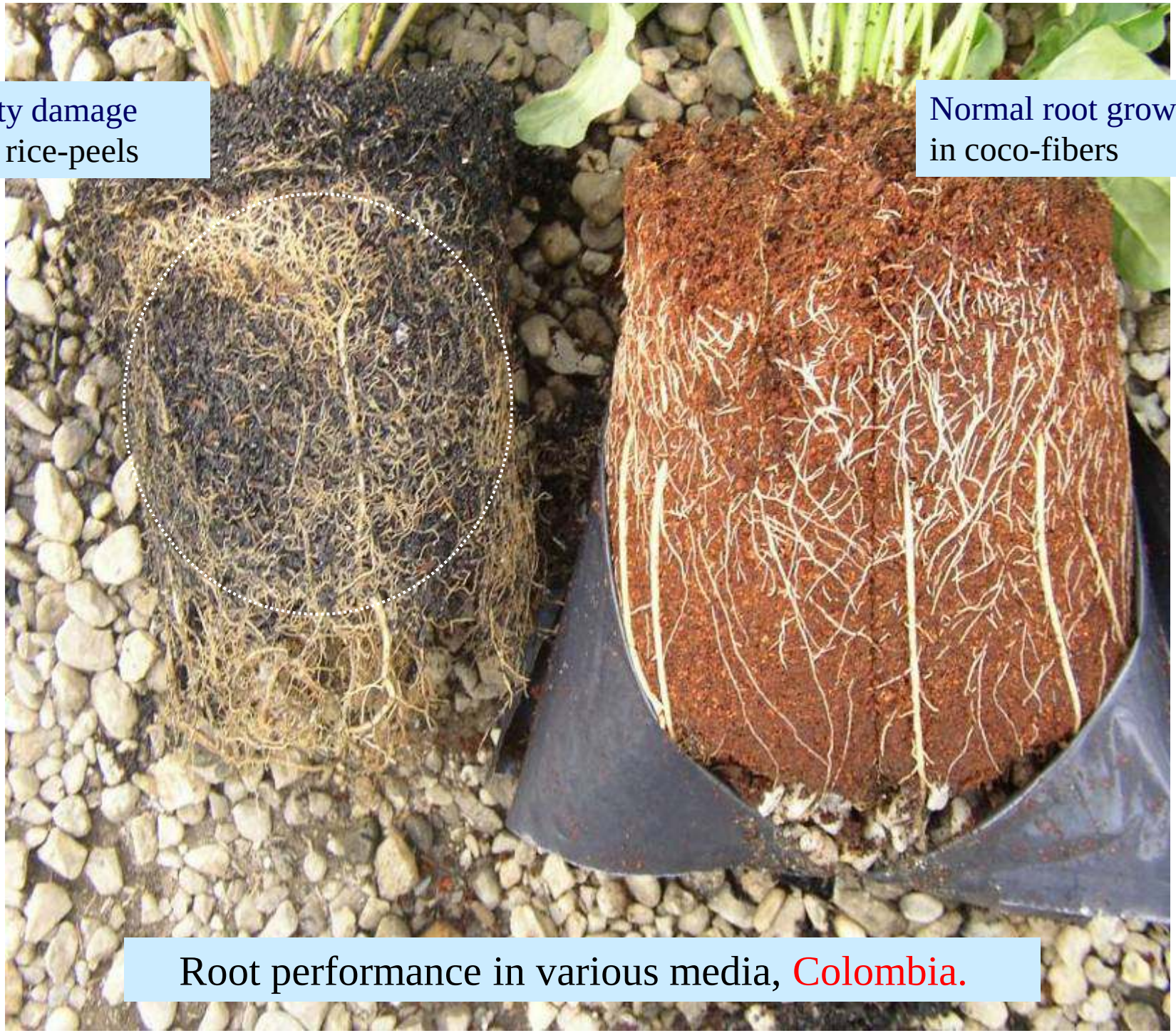
Salty layer in the soil-beds.

Salinity in the soil

India, June 2009.

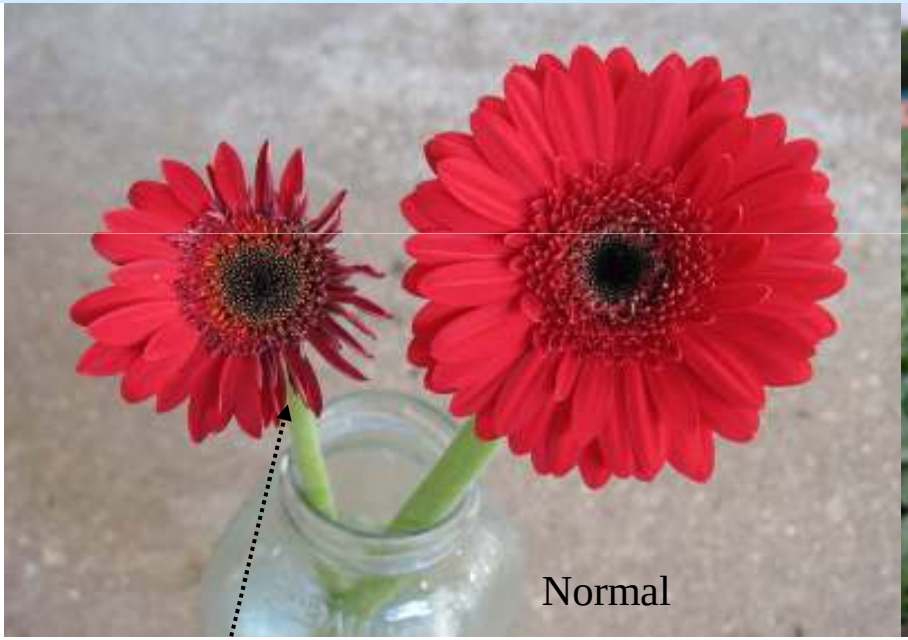
Total-loss of gerbera greenhouse

caused by salinity



Root performance in various media, Colombia.

Under 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**.**



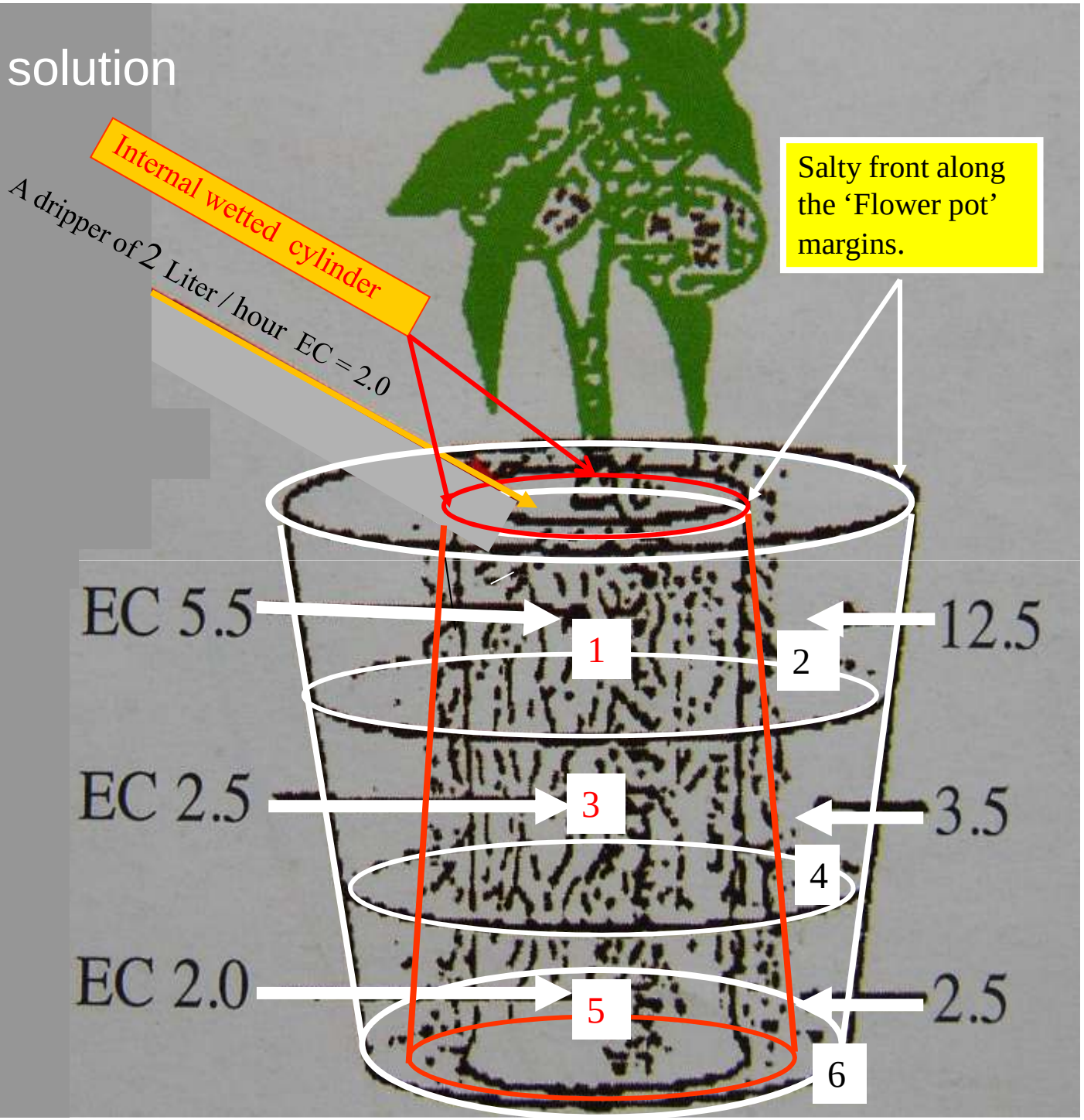
Physical damage to the flowers' petals

Typical damage in gerberas grown in soil, Ecuador

Salinity performance in gerbera flowers

Salinity in the soil solution

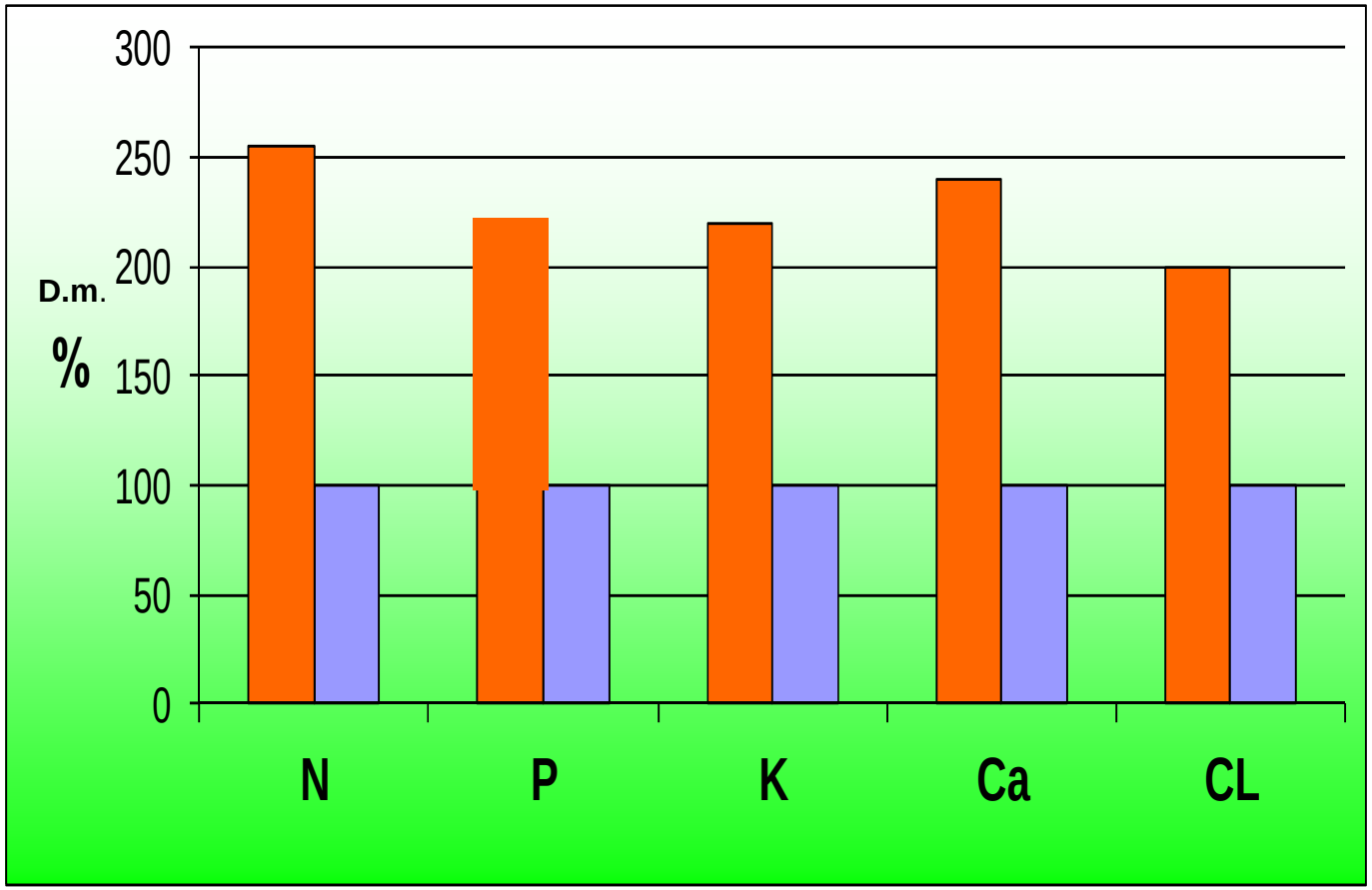
A real EC situation in 6 different sections of a flower pot, 6 weeks after planting.
Affected by gravity water-movement (*resulted by the water flow of 2 Liter / hour*).



Salinity in the plant-organs

Over feeding -
Ecuador, 2004.

Although the original EC of the water, before adding the fertilizers, was only 0.2 mmhos/cm, over feeding caused an accumulation of minerals in the leaves, and caused significant reduction in flowers production.
The leaves become rigid and breakable.



Gerbera Leaf analysis

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

Mineral accumulation in gerbera leaves, under 'over-feeding' conditions, vs. normal-fertigation. Salinity conditions 'Normal conditions'

Shoub Y. 2004, VII Simposio de la Floricultura, Colombia

Stages of salinity damage in gerbera:

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

C. FERTIGATION & SALINITY

- Fertigation = Irrigation + fertilizers at the same time.
- Water movement and salt accumulation.
- Oxygen availability and daily plant activity.

Water consumption and Irrigation

Generally saying :

A mature gerbera plant consume in Subtropical summer conditions,

above 500 cc of water per day.

Less water than this minimal daily amount leads to salinity problems.

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

Temperature, humidity, winds velocity, light intensity, soil or media porosity, water holding character, and drainage quality.

Water quality. amount of fertilizers, the irrigation system, the drippers volume, the container volume and shape, Salt accumulation , etc.

Most of these parameter can be checked and even can be controlled by us,

the sooner the better.

Therefore; Our advice to our gerbera growers in South American countries

is to irrigate gerbera plants in containers ,not less than 600cc per day.

And better to divide the daily quantity for 4 to 6 irrigations.

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

* EC of the fertilizers added above the EC of the local water

B. Saving formula 400 - 500 gr. fertilizers / 1000 L = ~ 50% saving

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

Conductivity	Acidity	Macro elements (ppm)						Micro elements (ppm)				
EC*	pH	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 of the fertilizers added above the EC of the local water

+

+ Boron

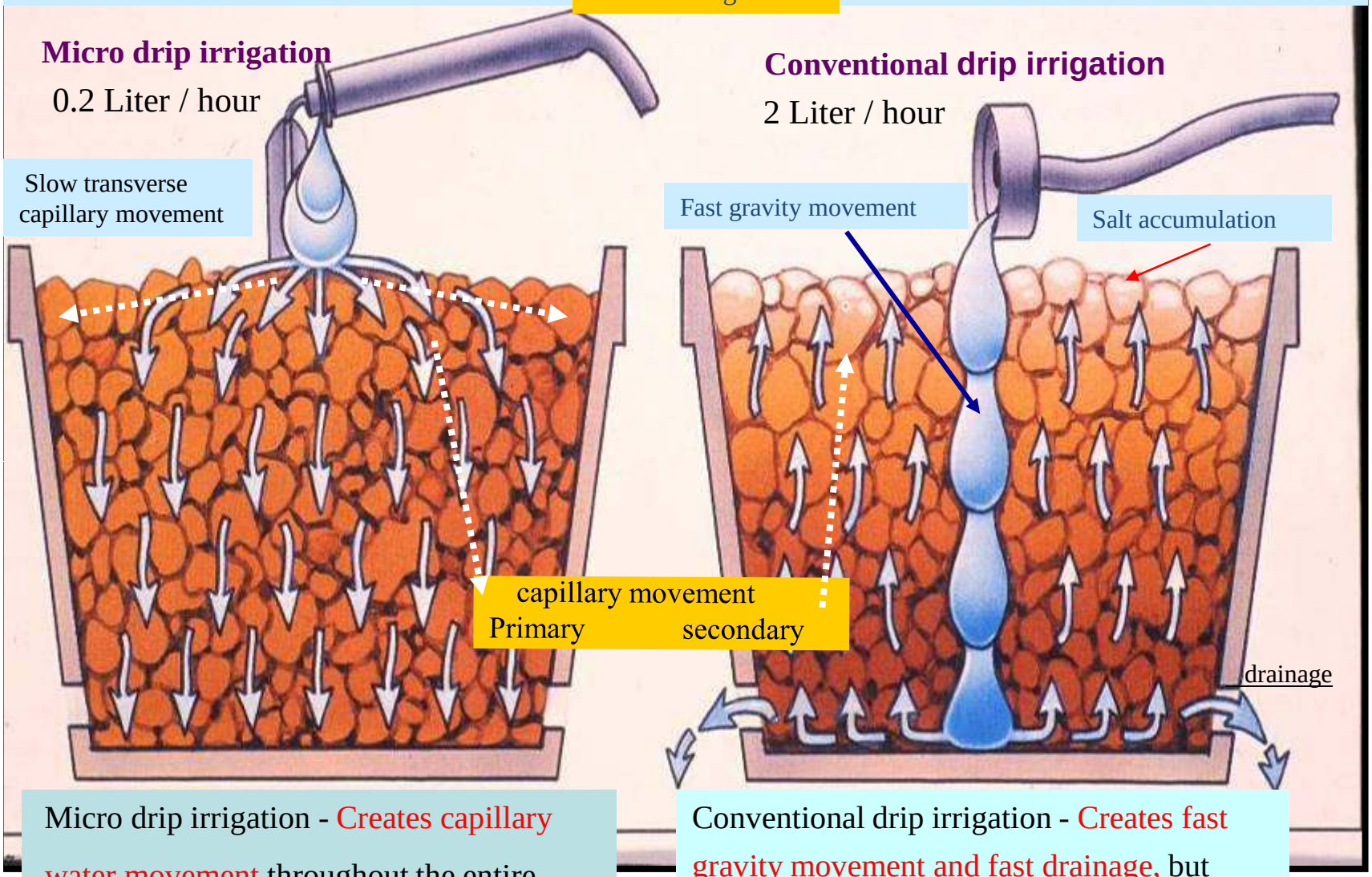
Refreshing temporary-wilted plants

If by any case the media in the container dried up (for example blocked drippers) and the plants temporarily wilted , →
and not as a result of salinity,

than, after normal one long irrigation the wilted plants will recover after few short hours. →

Water movement in the soil - Capillary vs. Gravity, and salinity development.

schematic figures

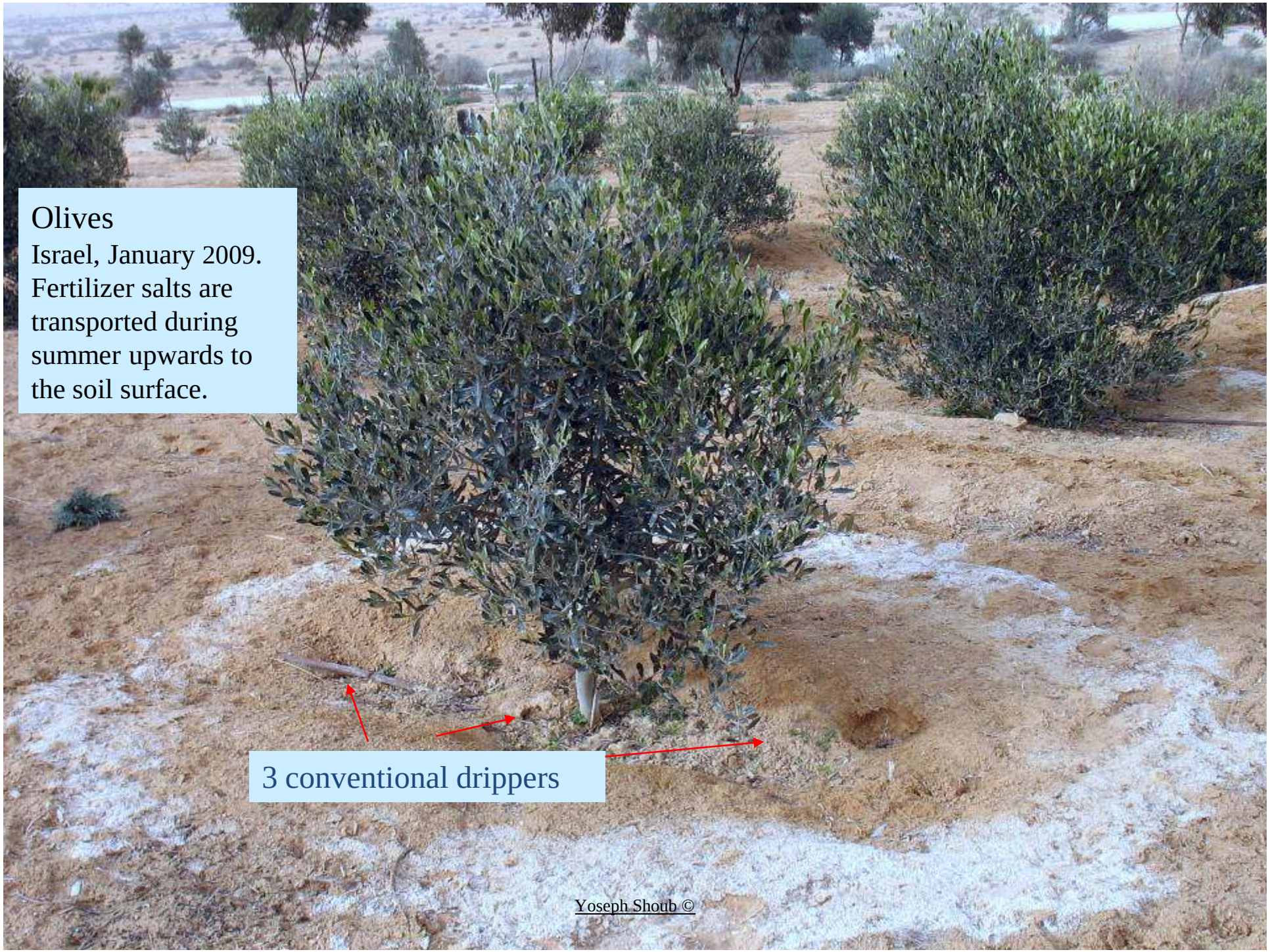


Micro drip irrigation - Creates capillary water movement throughout the entire root volume and helps to avoid salinity damage.

Conventional drip irrigation - Creates fast gravity movement and fast drainage, but at the same time promotes upward capillary movement of minerals = 'Salinity'

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

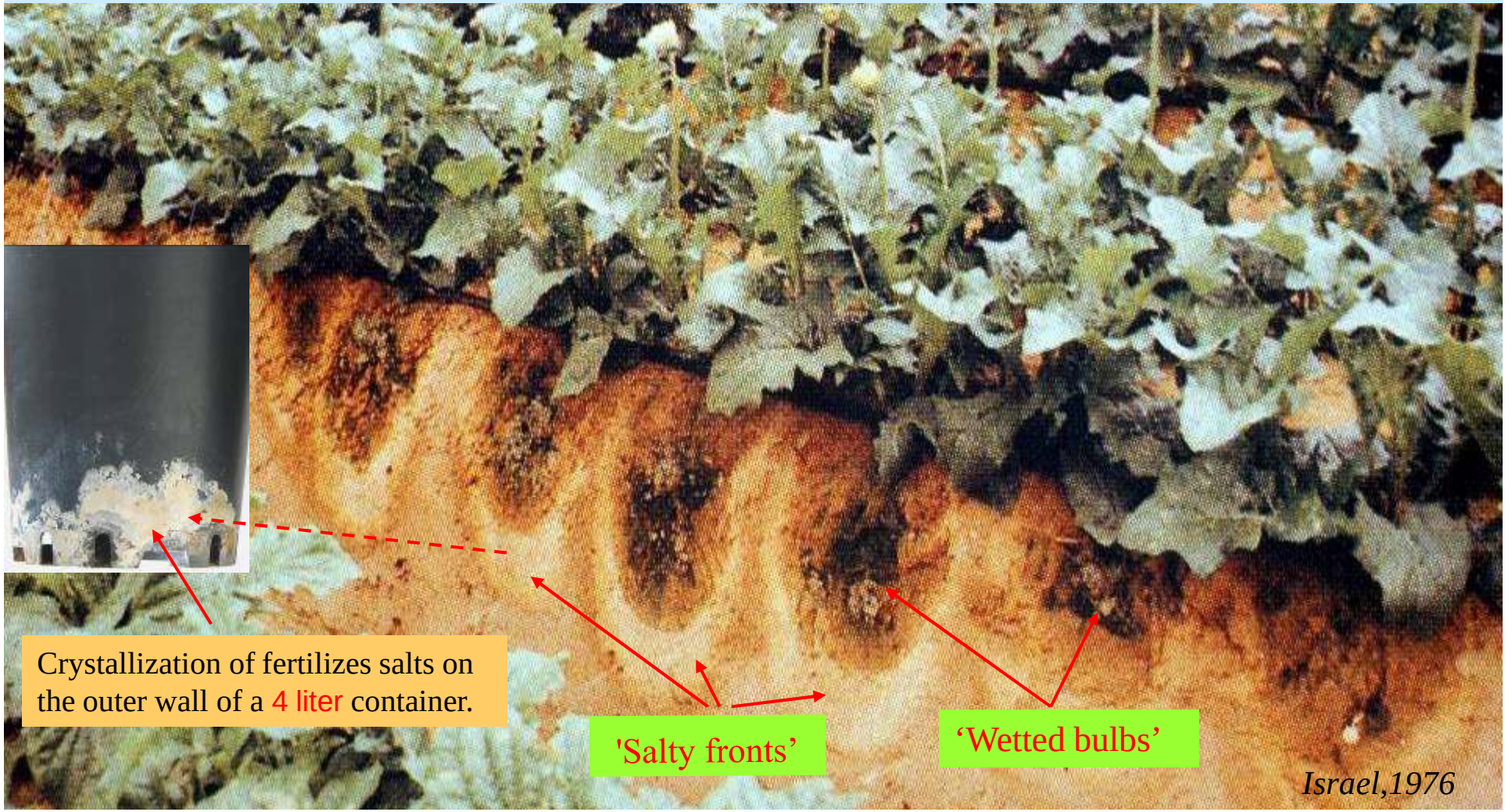

During conventional fertigation, most of the water movement is by gravity, but secondary capillary movement draws fertilizer salts upwards. Gypsophyla 4 weeks after planting. Ecuador, 2005.
2 L/h dripper


Olives
Israel, January 2009.
Fertilizer salts are transported during summer upwards to the soil surface.
3 conventional drippers
Yoseph Shoub ©

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 !

Gerbera Israel, 1976



Mineral deficiency as seen in these leaves, could be a result of salinity conditions (root burn), or other damage to the roots (Nematodes), and not a result of deficiencies in the soil solution.

Change of the leaves' **color**, may happen due to low temperatures that may affect the roots ability to absorb minerals, and it is not necessarily a result of salinity.

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 lies in the soil-solution and not in the soil structure.

The daily plant activities - (short summary)
Plants utilize - water, light energy, CO_2, oxygen and minerals for the following processes: (see next slide)

Respiration - occurs throughout 24 hours, Oxidation processes utilizing oxygen – supplying the energy for the biological activities.

Transpiration - occurs throughout the day hours. It is for the necessity of cooling the plant tissues and avoiding radiation damage.

Water carrying oxygen and minerals is transported from the soil solution.

Assimilation - of CO_2 and water, supported by light energy (photosynthesis), occurs throughout the day hours. A process that produce the carbohydrates (sugars) needed for the plant activities.

Translocation - occurs throughout the dark hours. First transport of water, oxygen and minerals from the soil solution to the leaves for diluting the sugars' high concentration. And than transport of Carbohydrates-products, from the leaves to all the growing sites.

Growth and development - occur throughout 24 hours, (many processes involved).

Logical conclusion -

And as plants 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 crops constantly throughout the day and the night as well.

And for that we need modern control-irrigation-systems.

Such Sophisticated Practice is already exist – The ‘AutoAgronom’ Irrigation Control system, already used in our gerbera breeding farm, in Israel. Saving water, saving fertilizers and getting better production.

.

D. Growing Conditions for Gerberas

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 difficult to control without automatic tools.

The coming chapters deal with the practicable growing conditions that gerbera growers can achieve and control.

Uniform growth of gerbera seedlings in containers 60 days after planting in a controlled growth conditions. April 2012, Gerbera Breeding Ltd, Israel.

Drainage efficiency of different Maceta types and oxygen availability -

‘Container’ versus ‘Flower Pot’

4 Liter 5.5 liter

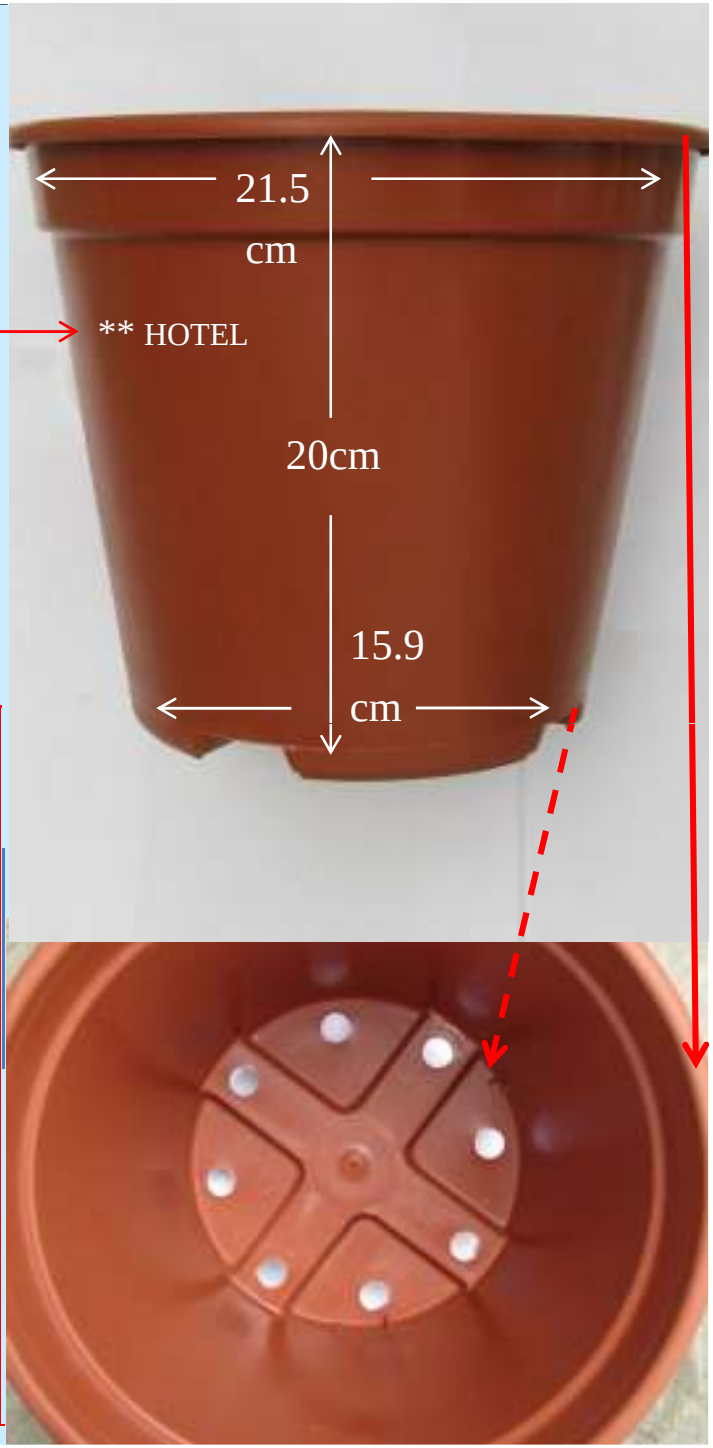
$$1.35 = \frac{\text{height}}{\text{average width}} = 1.06$$

Total surface of drainage holes:

3040 mm2 1060 mm2

The Advantage of growing plants in containers, is the ability to control the drainage.

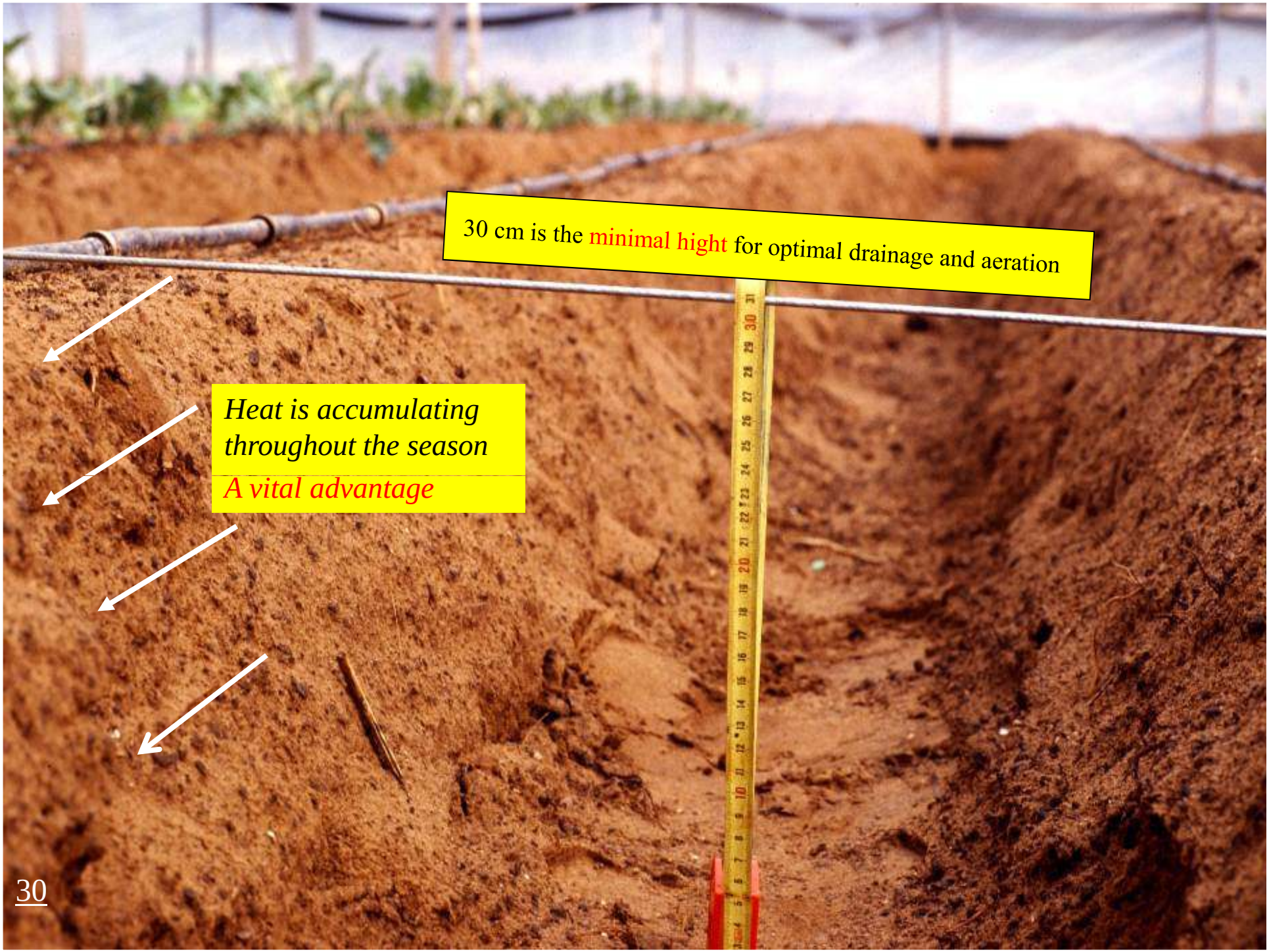
Physically the draining action is pumping air into the root’s zone, enriching it with oxygen.



Precondition for Uniform growth of gerbera in soil, is high soil beds, Israel.

Uniform growth in sandy soil

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


30 cm is the minimal hight for optimal drainage and aeration
Heat is accumulating throughout the season
A vital advantage

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.

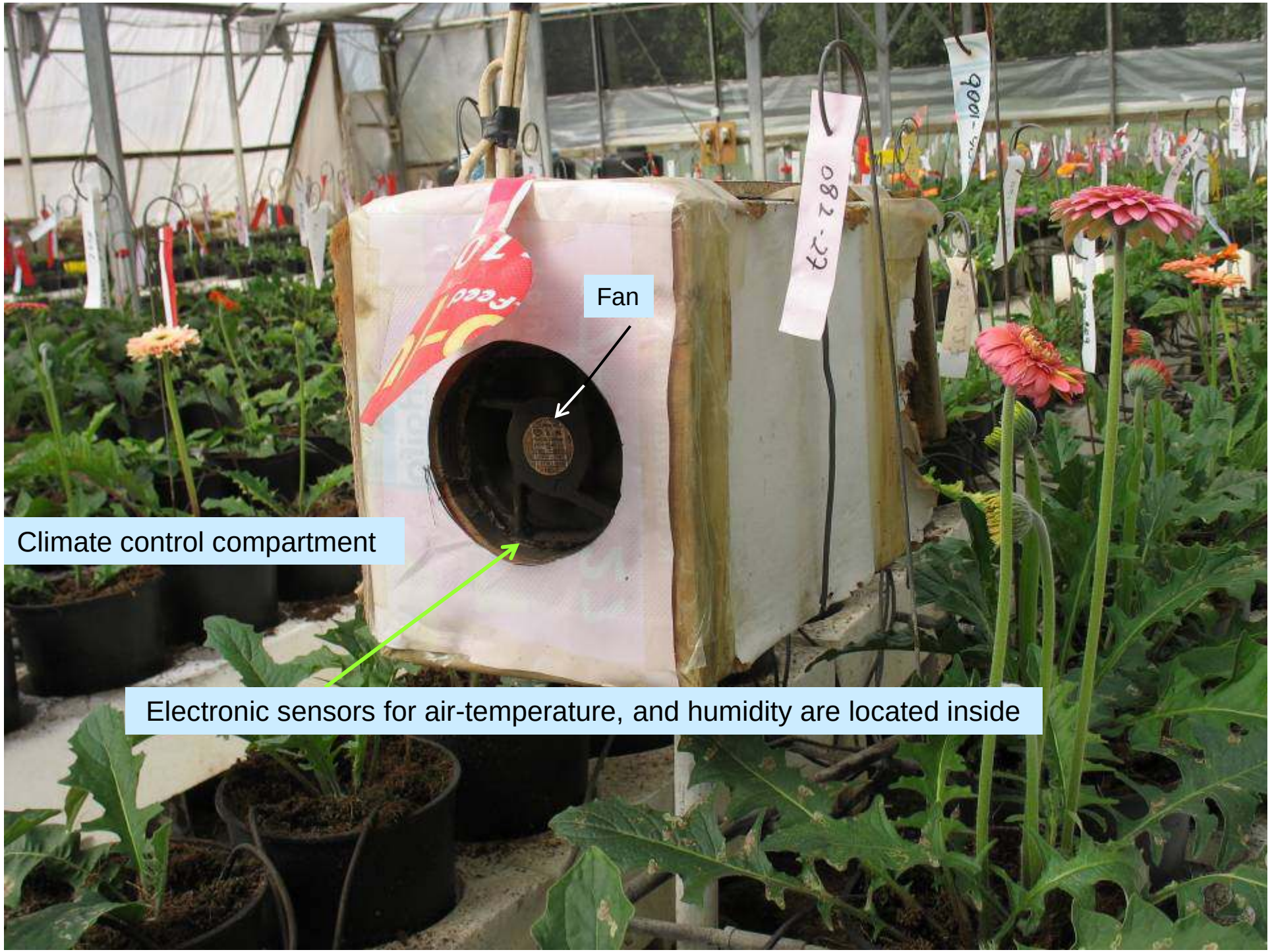
In fact, out of the total direct sunlight, only 2-3 % is transformed into photosynthetic energy.

Photometer in

Our greenhouse

Gerardo Mercurio - 2002 Gerbera cultivation in greenhouse.

Total Energy transformed by the plant for photosynthetic energy is only 2-3%


Fan
Climate control compartment
Electronic sensors for air-temperature, and humidity are located inside

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 - 17C are optimal for growth and for high quality stems & 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.

Our varieties where selected in the past under 8 -12C as winter nights temperatures.
For the last 6 years we select our new varieties under lower temperatures without heating.

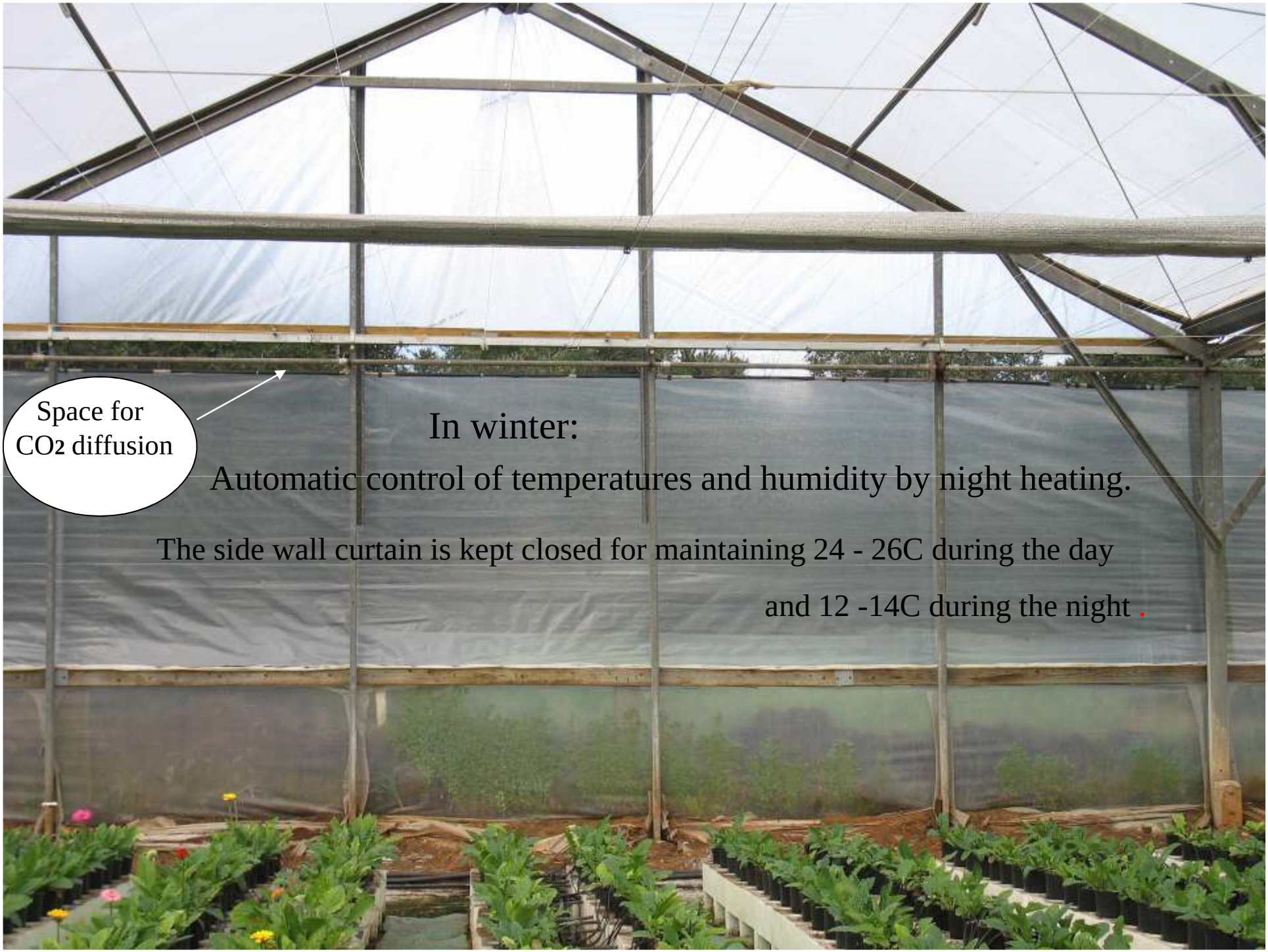
Controlling greenhouses without heating

Maintaining air movement in the greenhouse during winter nights, helps to prevent Botrytis.

Therefore, the greenhouse' walls'-curtains should left open, from late afternoon until early next morning. The natural air movement keeps the temperatures and the humidity in the greenhouse, relatively close to the outside conditions.

Note, that in greenhouses without heating the temperatures at night, might be lower and the humidity might be higher than in the outside conditions.

Mechanization control is advisable even in greenhouses without heating!

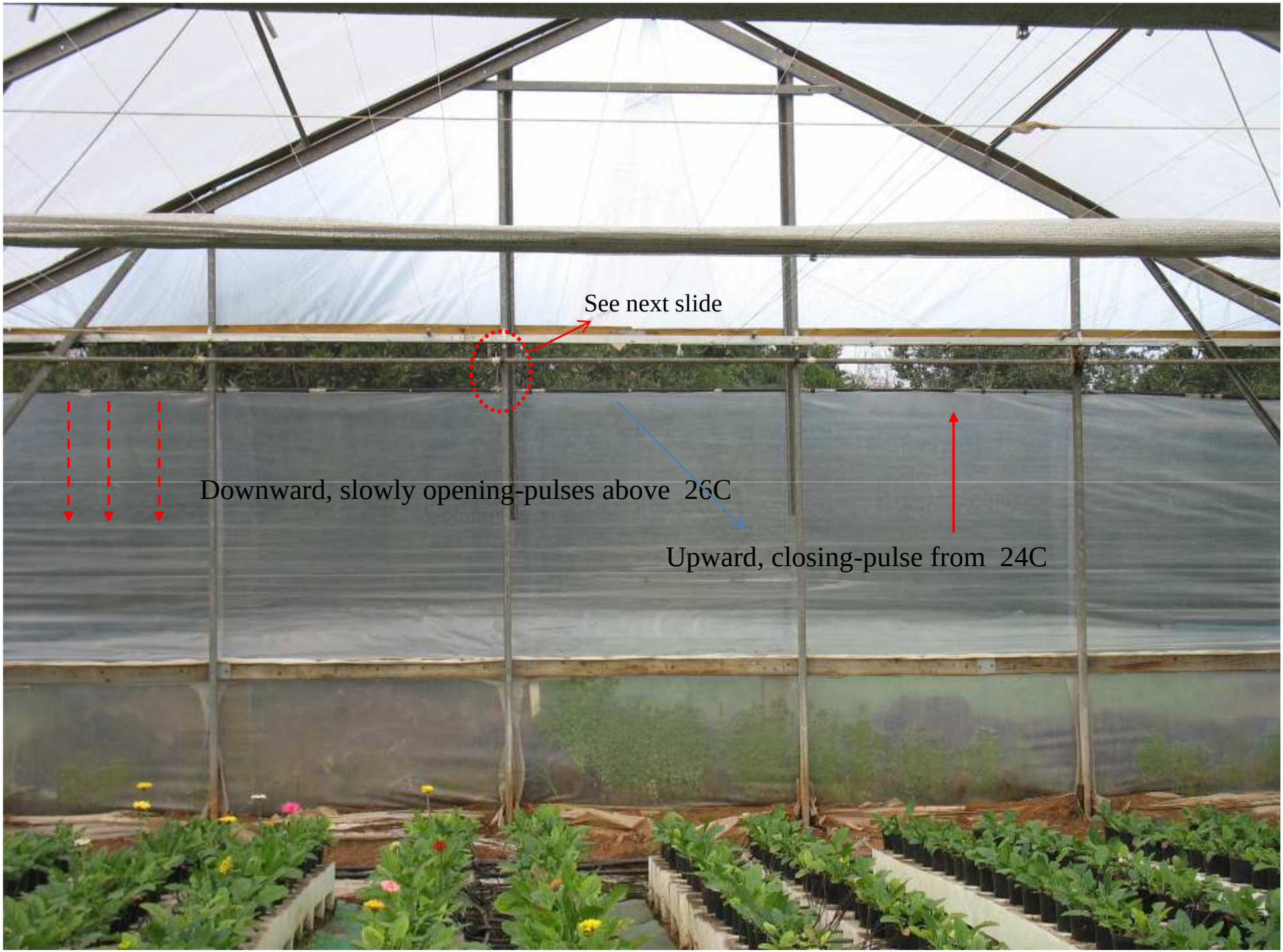


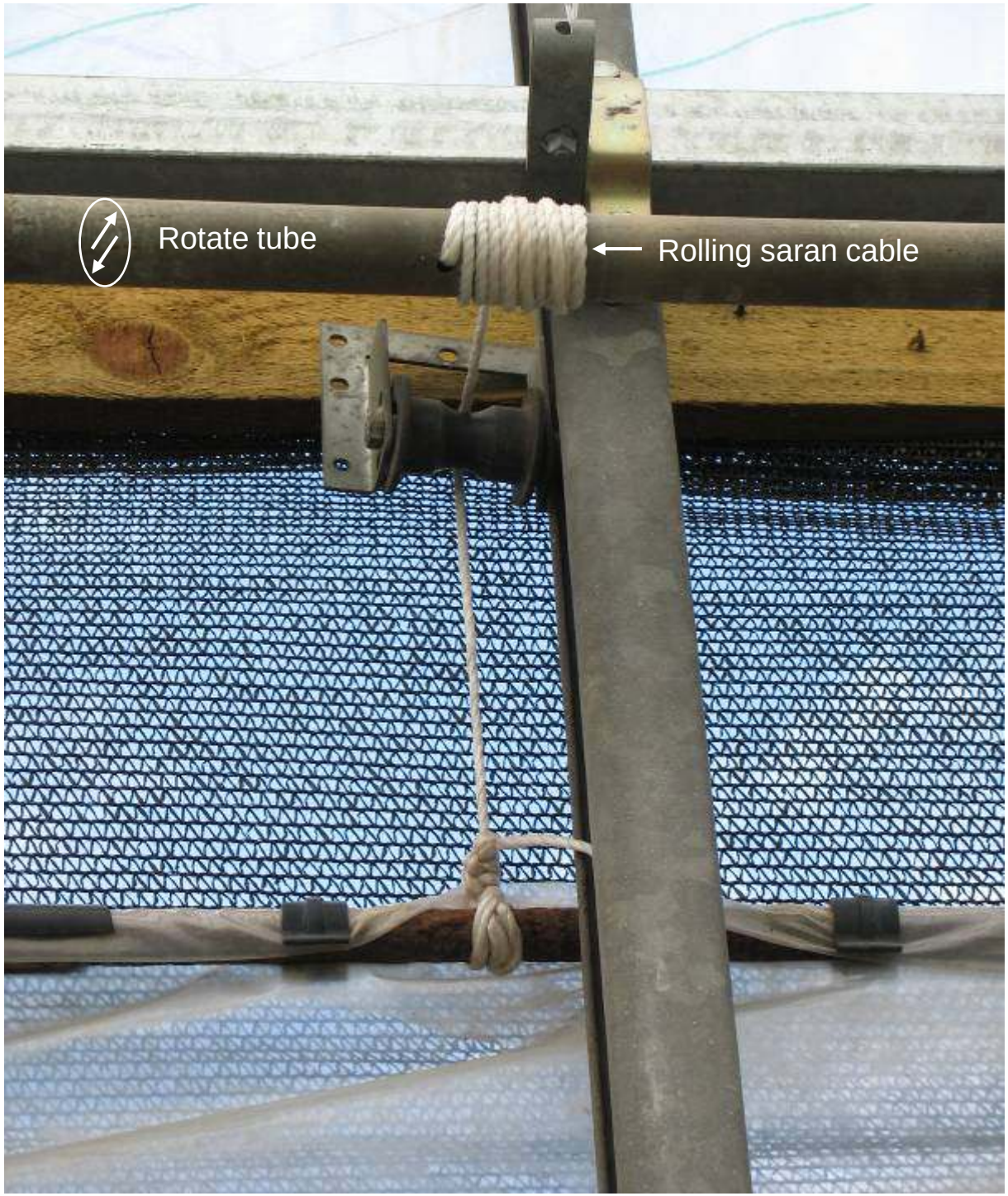
In winter:

Automatic control of temperatures and humidity by night heating.

The side wall curtain is kept closed for maintaining 24 - 26C during the day

and 12 -14C during the night .


See next slide
Downward, slowly opening-pulses above 26C
Upward, closing-pulse from 24C


Rotate tube
Rolling saran cable

Automatic open / close engine

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_2 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 greenhouse, 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 that very low humidity, resulted of dry hot winds, can cause damage like salinity.

Relative humidity

Relative humidity is a term describes in percentages (%), the possible ratio between the actual quantity of water vapors present in the air (grams / 1 cubic M), to the total quantity of vapors that the air can hold as vapors (at constant temperature and pressure).

$$\frac{\text{water vapors present actually in the air}}{\text{total water vapors the air can hold}}$$

An example: 1 cubic M of air at 20C, could hold 17.3 grams of water vapors. Therefore, if the absolute quantity of vapors is only 13 gram, the relative humidity is ~ 75% (13 : 17.3 = 0.75)

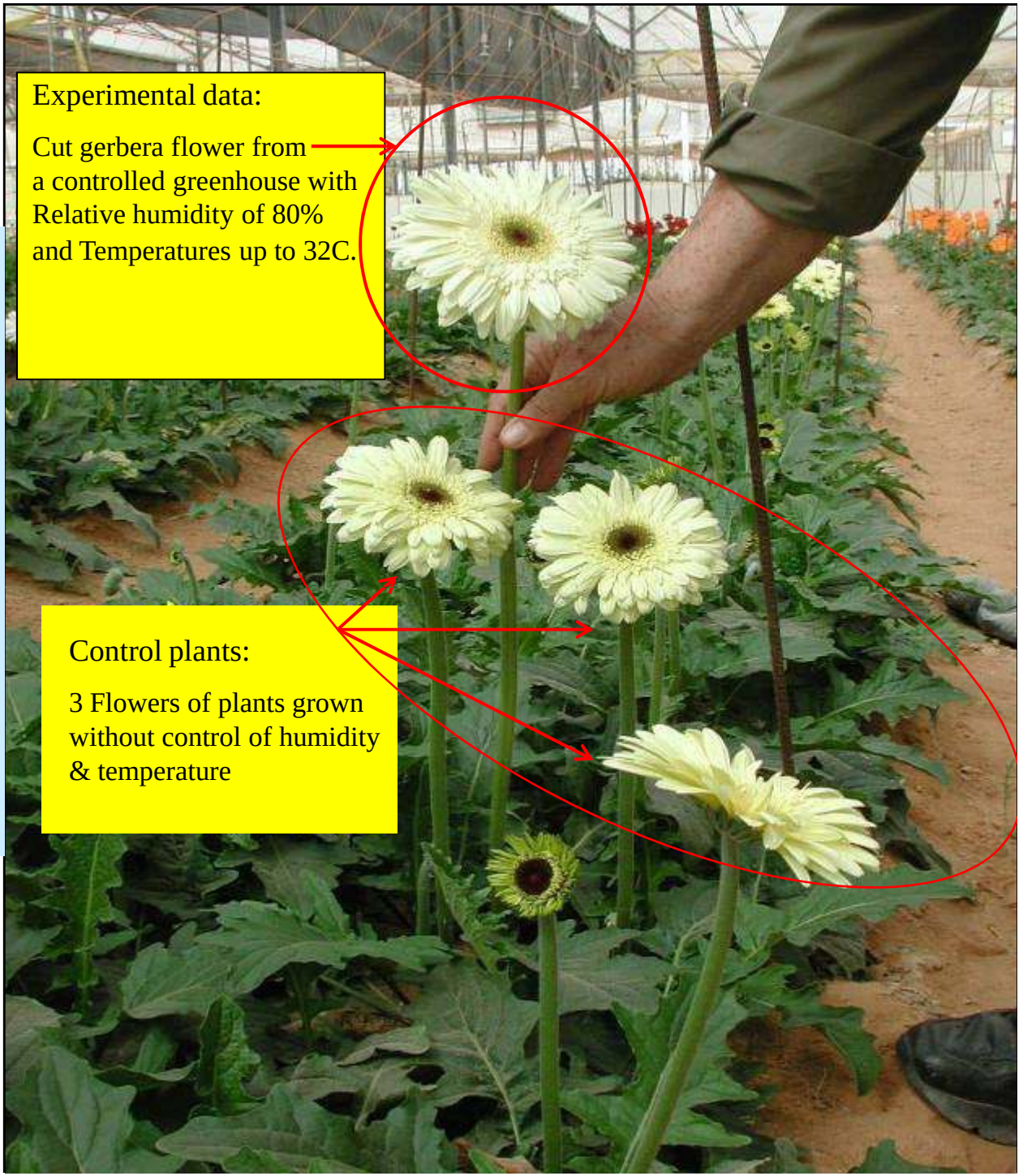
Condensation point

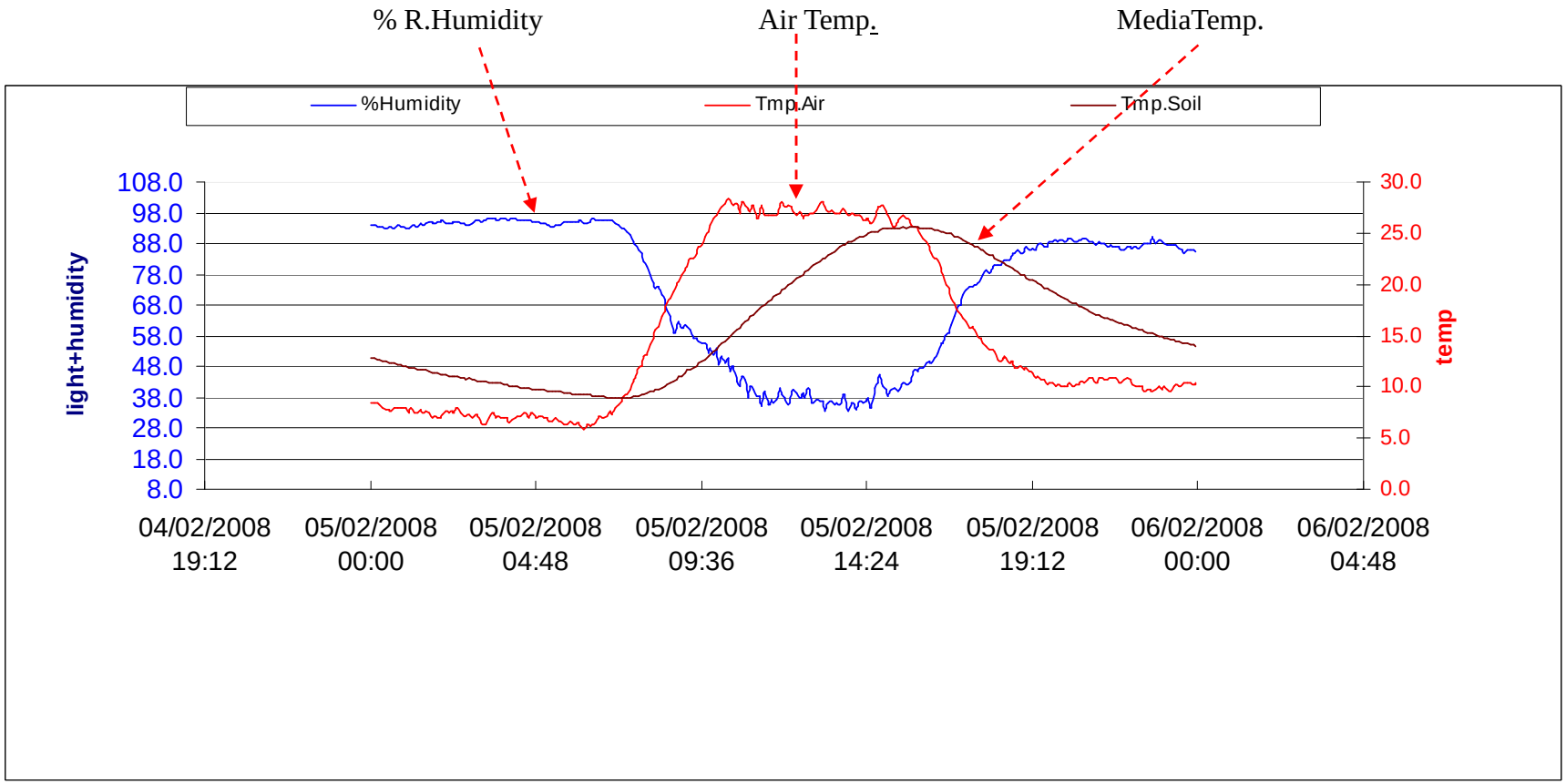
Condensation point is a situation when the relative humidity reaches 100%.
Above this point, the vapors will condense as water film, on the greenhouse structure, on the inside greenhouse cover (roof & walls), and on the plants tissues (dew point), enables the conditions for Botrytis and other diseases.

Gerbera trials at 'Arava' Research station, south Israel.

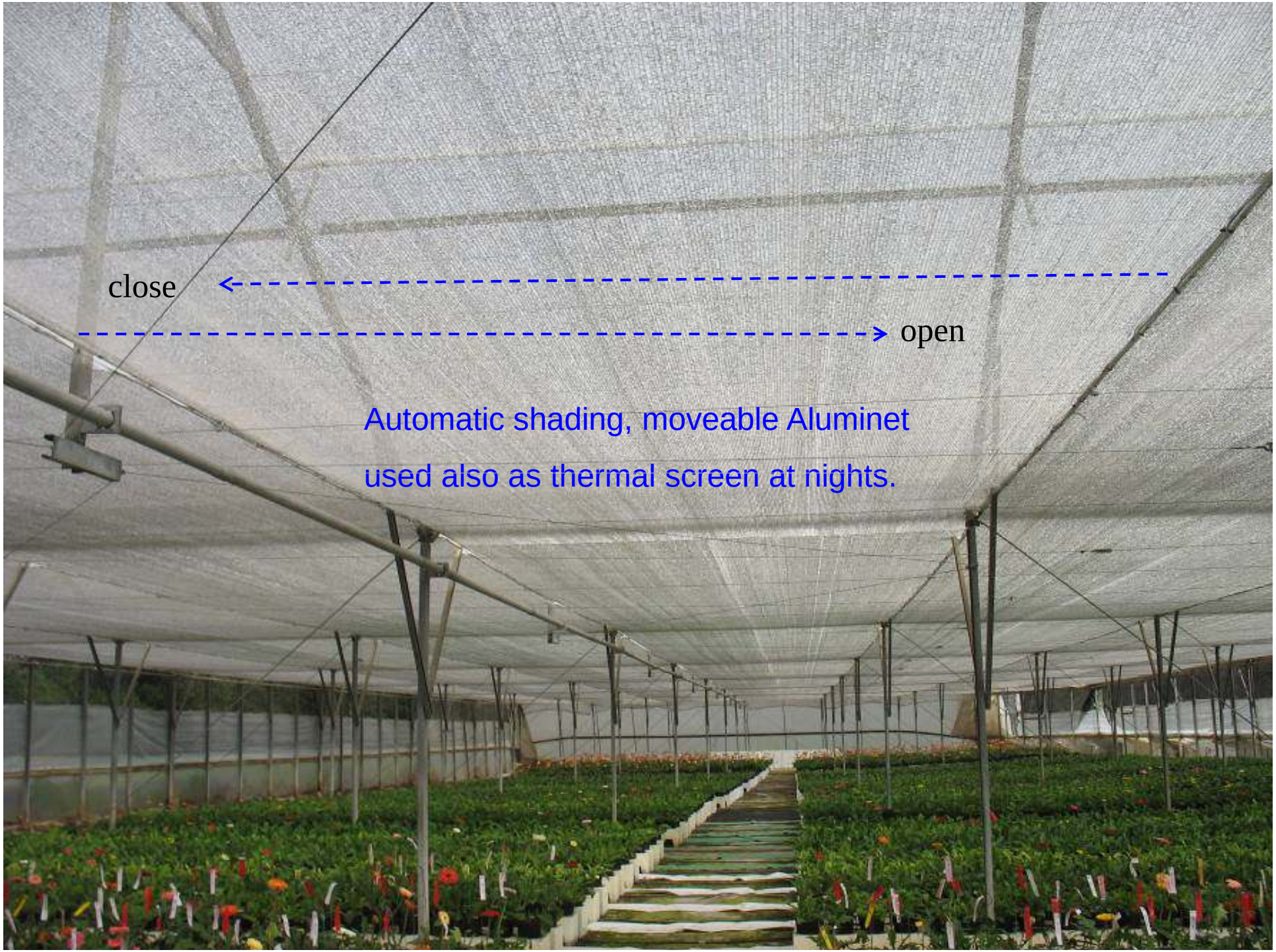
March 2006 *

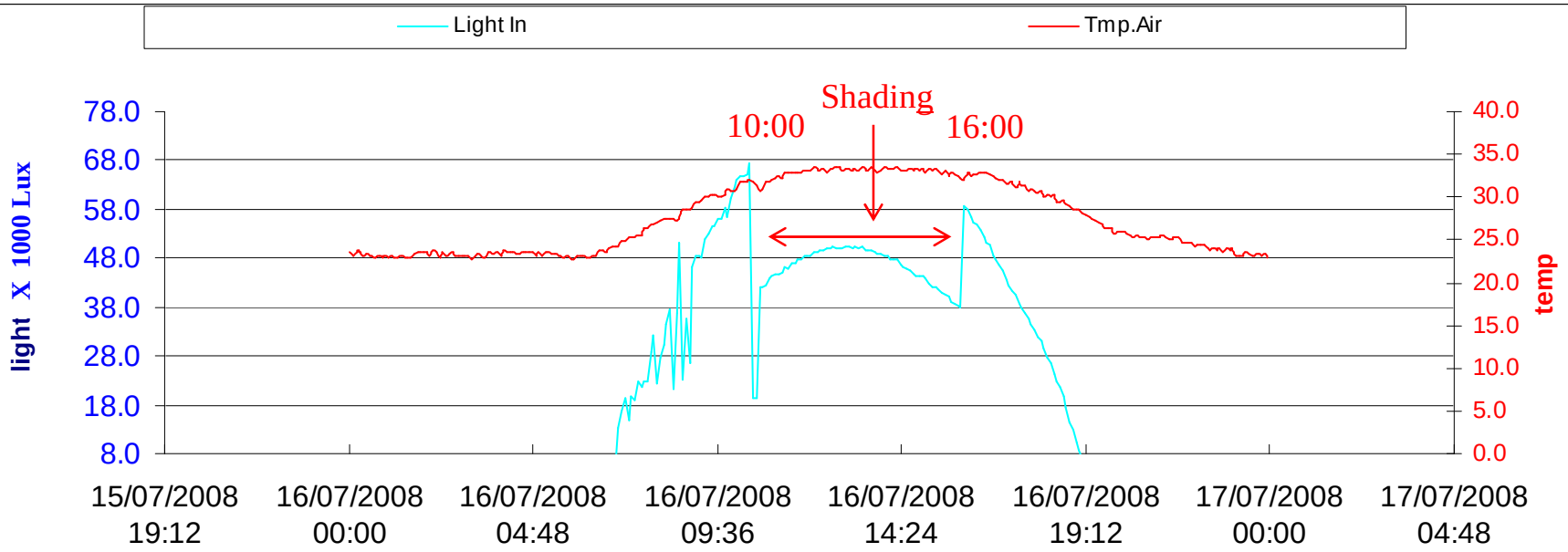
*The climate in this region throughout the year is dry, and summer is very hot .





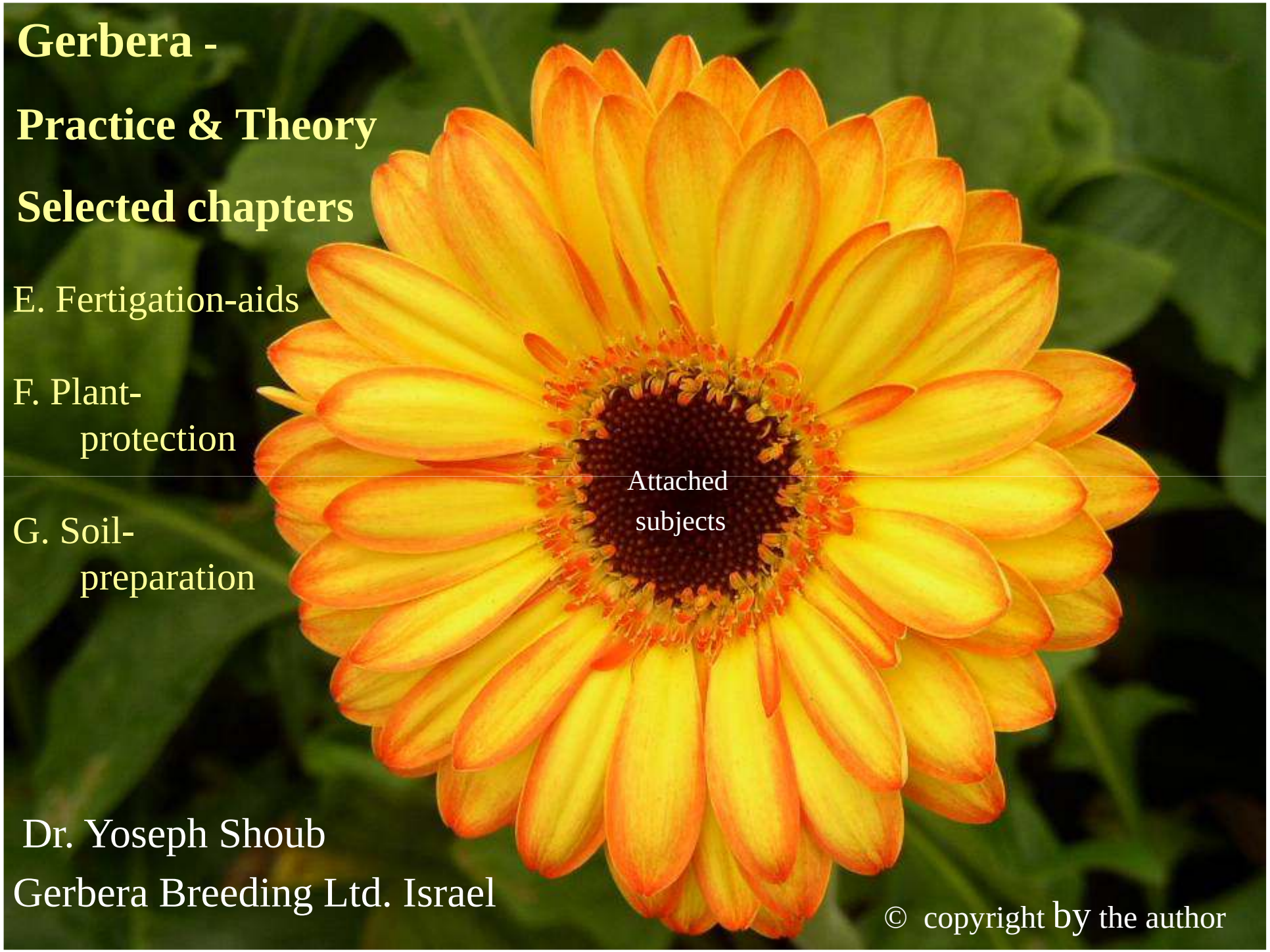
Relative humidity, air temperatures, and the temperatures of coco- peat media in 4 L. containers, in our 'Auto Agronom' controlled greenhouse, Ganey Am, February 2008, Israel .


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



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


The end
of lecture 2



Gerbera -

Practice & Theory

Selected chapters

E. Fertigation-aids

F. Plant-protection

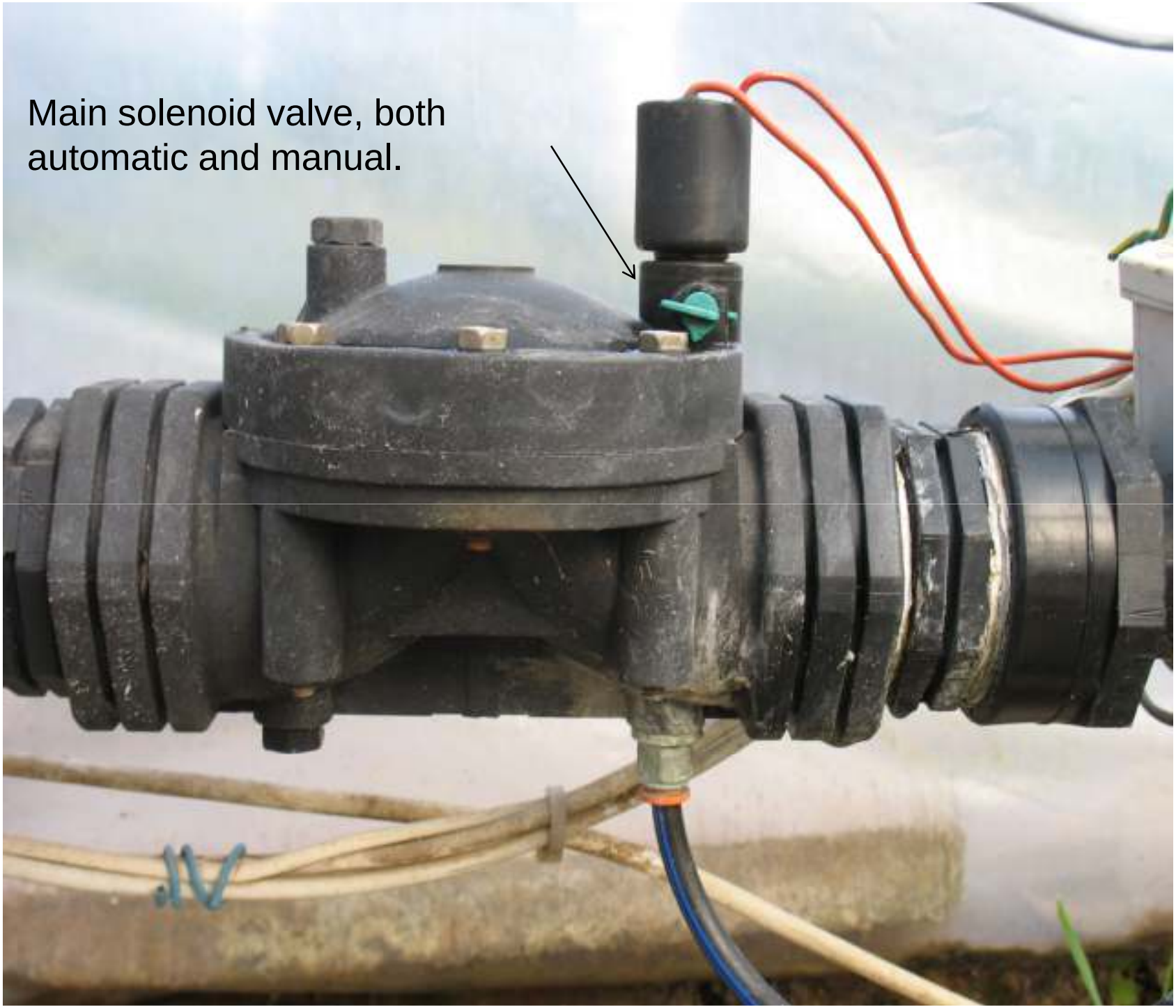
G. Soil-preparation

Attached subjects

Dr. Yoseph Shoub
Gerbera Breeding Ltd. Israel

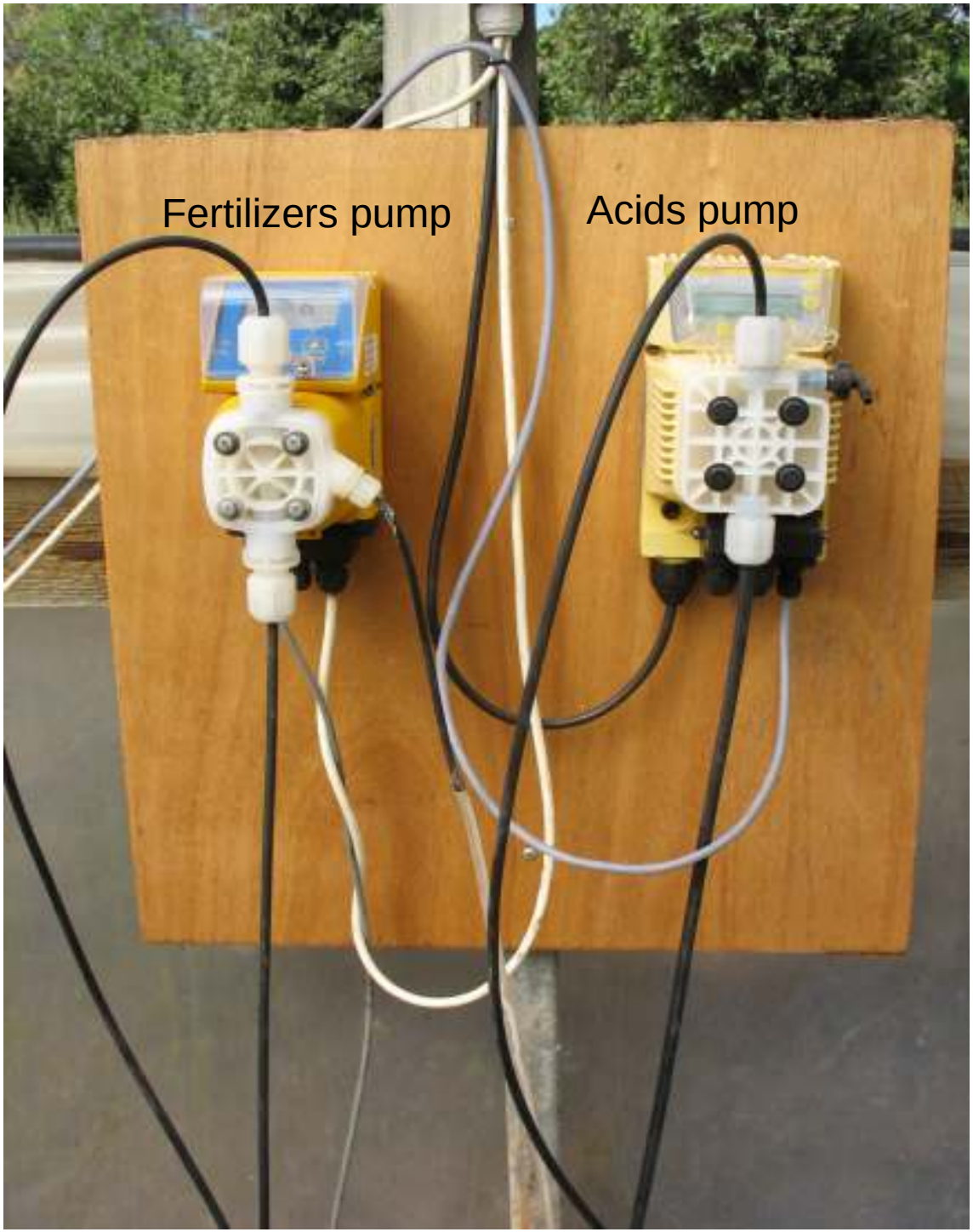
E. Fertigation aids -

Friendly manual water filter


Main solenoid valve, both
automatic and manual.


3 Tanks automatic system
Ca + Mg
Acid
Fertilizers

Electric dose pumps
for chemicals



One-way injecting regulator.

One for fertilizers

One for acids


Fertilizers sediments filter

F. Plant protection - M a i n p e s t s & d i s e a s e s

Potential Fungal Diseases

Botrytis cinerea *****
Phytophtora cryptogea **
Sclerotinia sclerotiorum **
Oidium - Mildew ***

* Mites

Tetranychus urticae **
Polyphagotarsonemus latus *****

General Insects

Aphids spp. *
* Trialeurodes vaporariorum & Bemisia tabaci - White fly *****
* Frankliniella occidentalis - Thrips *****
* Liriomyza trifolii - Leaves miners *****
Spodoptera littoralis - Caterpillars *

Nematodes

Meloidogyne spp. *****

---

* *Biological control is very effective in controlling the green dotted pests*

Disinfection with Edigan + Condor, or with other chemicals

Nematodes - The biggest problem of gerberas grown in soil.

Mixing the greenhouse-air during the cold-night-hours, can avoids Botrytis, Colombia.

Botrytis cinerea

Optimal conditions for botrytis are: continuous low night temperatures for 7 to 10 hours, + 85 - 100% relative humidity, in condition that water film covers the plant tissue.

P e s t i c i d e s - apply and risks

Warning – Read carefully the chemicals labels and calculate accurately weight and percentage

Spray injury on flowers.

The same damage can be seen after frost conditions.

P h y t o t o x i t y on flowers

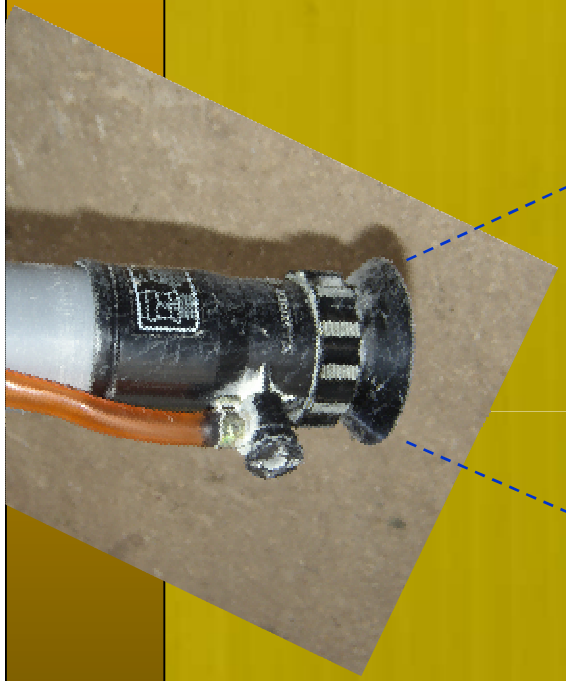
Damage of a Systemic fungicide

The Same variety

Normal mini flower,

Phytotoxity on leaves

Phytotoxity damage of ‘Systemic’ fungicide, 40 days after the spray,
it looks as minerals deficiency. Better to remove all the damaged leaves.



Spray injury - is seen on all the stems along the plants line, on the same side of the stems.

The stem tissue is probably damaged because of the high chemical concentration + the sensitivity of the variety.

G. Gerbera in soil:

Preparing the growing conditions for the next season - Smash-up the previous plants.

Loosening the soil beds

Subsoil ploughing

The sizes of the common two plants lines soil-beds:

Height - 35 to 45cm.
Width - 66cm. (upper level)

Pathways - 45cm.

Slopes - 11cm.

Plants line - 13cm. from bed shoulders.

Between plants lines - 40cm.

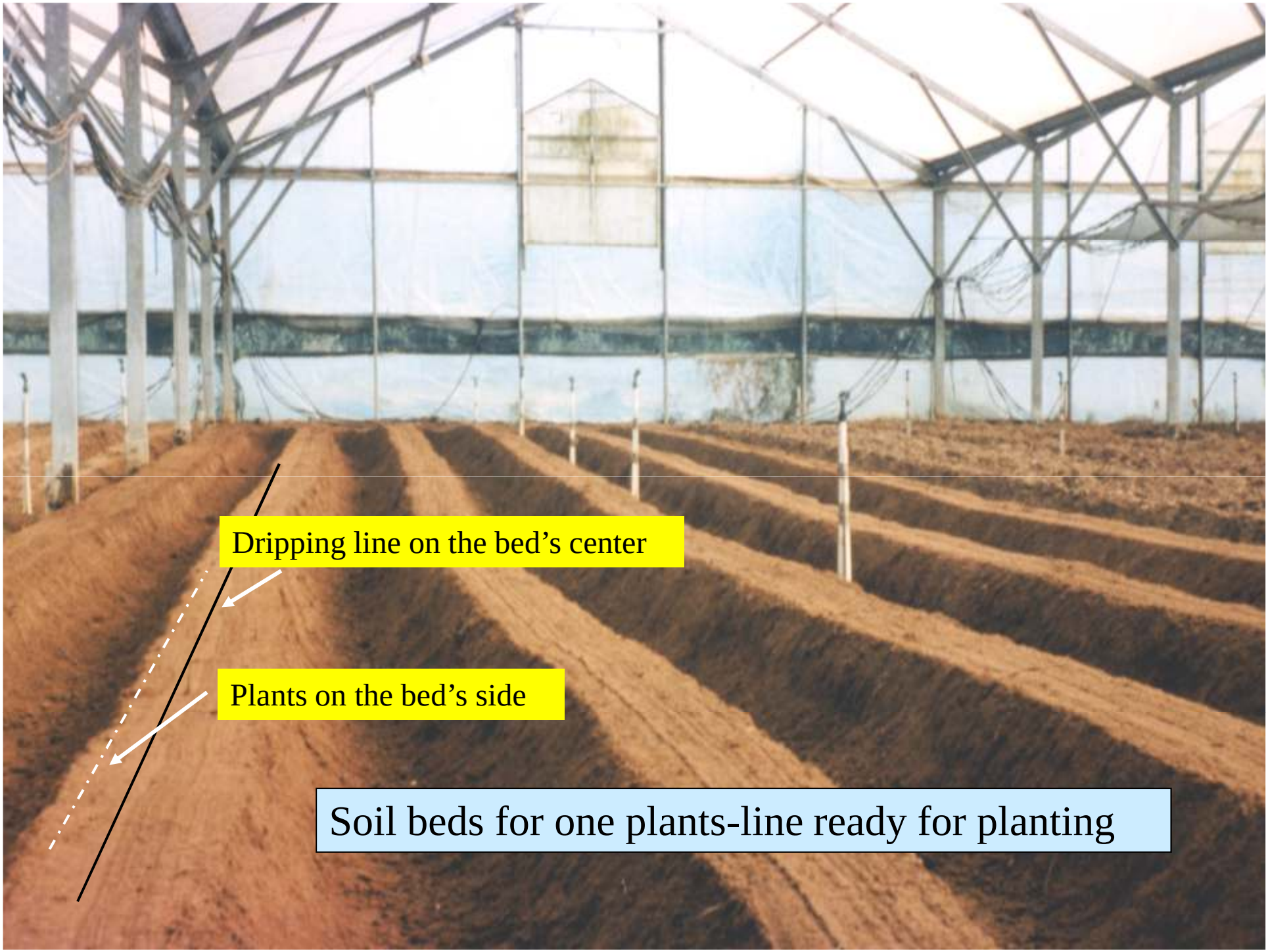
In the line - 20cm. +

Dripping tubes inside the bed,
and close to the plants.

The soil-beds are stable for

more than one season.

Raising soil beds for one plants line



Soil beds for one plants-line ready for planting


The end

Dr. Yoseph Shoub authentic Photography 2008_