"The roots of education

are bitter,

but the fruit is sweet"…

Aristoteles

"Culture and diseases of Pelargonium"

prime genetics

Ben Geijtenbeek March 2014

FloriPro Services®

Attention to the green part of business

Key Important Points

- Try to be proactive in your management decisions, whether it is climate, plant habit, height, fertilization, insect or disease control.

- Don’t wait for problems to dictate your crop strategy.

Subjects

- *Pests and Diseases*
- *Preparation of season*
- *Water and Fertilizer*
- *Climate*
- *Practical problems to discuss*

Aphids

- Most species are 2-3 mm long, winged or non-winged.
- On its abdomen it has two syphones. The mouth part consist of 4 parts making a telescopic stylet.

- Damage:
  - growth reduction
  - deformation of growing tips, curling leaves
  - tiny yellow or brown spots on leaves
  - excretion of honey-dew

- Remove severely damaged plants and avoid high nitrogen nutrition since it increases the plants susceptibility.

Aphids

- Virus-transmission
  - by feeding aphids injects the virus into the plant.
  - The number of viruses than can be transmitted by aphids is about 400.

- Chemical control of the insect
  - pirimicarb
  - Methomyl
  - Pimetrozina
  - synthetic pyrethroids
  - thiamethoxam

Thrips

- Thrips are small (2mm), moveable (flying) insects.
- Most important: *Franklieniella occidentalis* (Californian thrips)

- Damage:
  - sucking on plant cells-> silver-white spots turning brown
  - black droppings
  - deformation of flowers, buds, leaves and growing tips
  - early flower dying
  - virus transmission
- Control:
  - Tapping on flowers above a white sheet of paper, blue and yellow sticky plates.
  - Early symptoms: near doors, along path

Thrips

- Egg-egg: 2-3 weeks depending temperature.
- Per female: 70-200 eggs
- Preference: young soft leaf tissue
- Pupation in soil
- Spread from company to company through working clothes, by wind, contaminated stock and equipment.
- Chemical control: acefate, abamectine, pirimifos, ..

Franklieniella occidentalis

Thrips: transmission of viruses

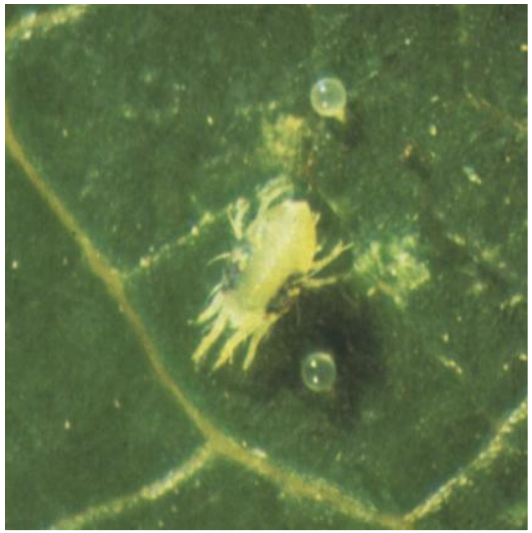
- *TSWV: tomato spotted wilt virus*
- *INSV: impatiens necrotic spot virus*

  - Insect (or larvae) feed on infected plant. Virus is absorbed and incorporated in its body.
  - *The virus remain in its body during the whole life-cycle.*
  - By injecting saliva, containing virus, a new plant is infected.
  - Symptoms of virus develop after 1 to 6 weeks.

Sciaridae (black flies)

- Small gray-black flies (1-3 mm) with Y-form in the upper part of the wing.
- Larvae small 2-4 mm, white with dark head.
- Damage through feeding of larvae (especially roots) linked to high soil humidity.
- Development from egg to egg: 3 weeks.
- Chemical control usually not needed.
- Biological control successful using nematodes (*Steinernema feltiae*) or mites (*Hypoaspis milis*).

Spider Mites



- Damage:
  - sucking on plant cells
  - deformation of flowers, buds, leaves and growing tips

- Control
  - abamectine, dimethoaat, pyridaben, vertimec…

Caterpillars (example)

- *Helicoverpa armigera*

- Watch traces of feeding

- Biological control successful with Bacillus thuringiensis

- Nomolt

Diseases (the most common)

- **Virus.** (supplier, handling, insects)
  - TRSV, Tobacco ringspot virus.
  - PFBV, Pelargonium flower break virus.
  - PLPV, Pelargonium line pattern virus.
  - PLCV, Pelargonium leaf curl virus.
  - TSWV, Tomato spotted wilt virus.

- **Bacteria.** (supplier, hygiene)
  - Xanthomonas campestris, Pseudomonas, Ralstonia *(potato's !!)*

- **Fungi.** (climatic actions)
  - Rhizoctonia, Pythium, Phytophtora, Puccinia (Rust), Verticillium, Botrytis, Fusarium.

How do virus enter a plant?

- **Viruses cannot enter a plant by itself; it needs a vector:**
  - via pollen grain (not in our crops)
  - via seeds (very uncommon)
  - via vegetative material (cuttings!)
  - via human handling in the crop (smokers!)
  - via insects like white flies, trips, mites, aphids and in some cases also nematodes.

Can you recognize a virus-infected plant?

- Latent infections: no visible symptoms. *DANGER!!!*
- Virus symptoms are:
  - Stunting is most common (but difficult to see since usually more plants are infected to different degrees).
  - Mosaics
  - Mottles
  - Ring spots
  - Color breaks (can be confused with 2,4-D or dichlorvos).
  - Distortions: cupped, strapped or unusually small leaves.
- Symptoms depends on host and temperature.

What should you do to prevent the spread of viruses?

- Start with a clean crop: CERTIFICATION.
- regular disinfection steps for hands and equipment.
- Use of disinfected growing substrate (in case of nematode transmission).
- Proper and consequent insect spraying.
- Prevent insects enter the greenhouse: keep doors closed, regular check on insect netting (maintenance).
- Don’t allow smokers to do anything, or even enter the glasshouse.
- Beware of fresh tomato’s and peppers in your lunch box.

What should you do to prevent the spread of viruses?

- Start clean and keep clean.

Certification is……

- A quality system for cuttings organizing internal and external quality.
- A guarantee that the utmost has been done to deliver disease free, true to type cuttings to our customers.
- A combination of clean stock programs with best management practices.
- Controlled by Naktuinbouw Elite®.

Why chose for certification?

- Cuttings are vegetative material.
  - Problems in one generation can easily be transmitted into the next.
  - Infection of viruses cannot be treated unlike infections of bacteria, fungi and insects.

- Safe, predictable production system.

  - Development of EPPO (European Plant Protection Organization) clean stock guidelines and Naktuinbouw guidelines on best management practices.

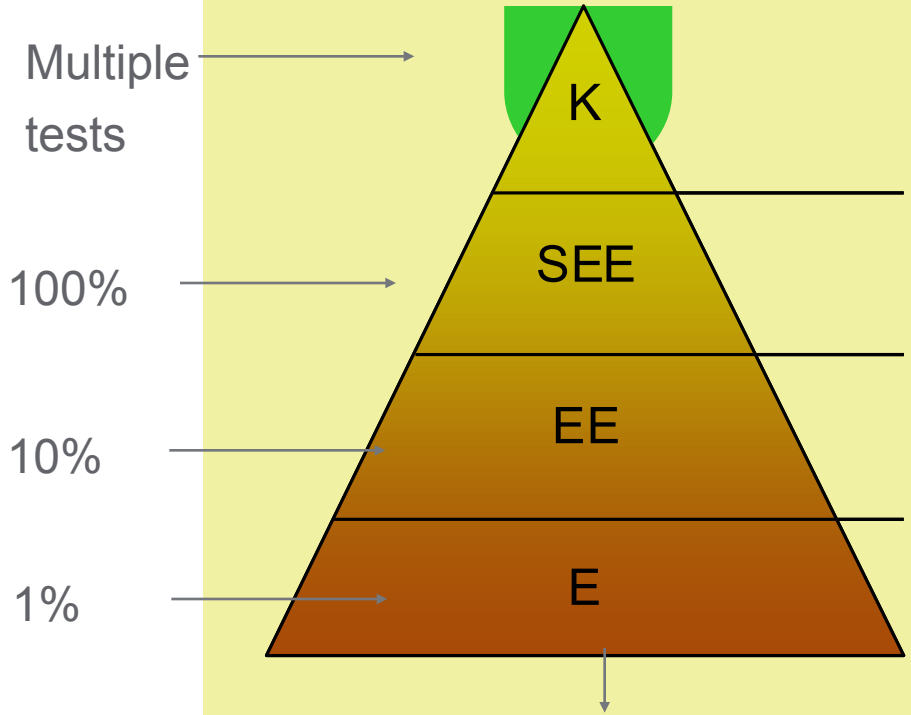
S&G policy on certified cuttings

- Fully tested, true to type, clean stock.
- Structured, controlled production protocols.
- Very, very strict hygiene.
- High traceability from prebasic to stock plants to URC and RC level.
- Regular testing of all crops throughout production.
- Obliged scouting program (insect management).

- So a lot of effort to make and keep disease free, true to type cuttings.

Certification system for production of cuttings

Naktuinbouw Elite® Certification



- Candidate plant
- Nuclear stock (Pre-basic)
- Propagation stock (Basic)
- Certified stock (Certified)

Certified Elite ®-cutting (URC)

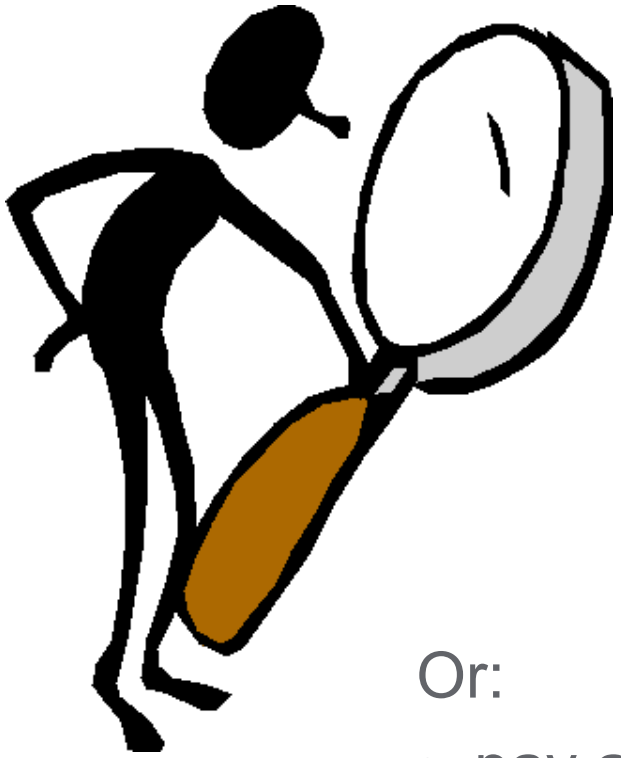
Certified Elite ®-rooted cutting (RC)

How to enter a certified greenhouse? , or your greenhouse?

- Wash hands (dip in disinfectant), change shoes.
- Only non-smoking employees!
- Regular disinfection steps for knives/hands.
- Split into certified and uncertified compartments.
- Culture free from soil surface. Use of clean substrate, clean water, clean pots, clean driplines, etc.
- Limited access for visitors.

- **Rule out humans as transmittors of infection.**
- **TMV infects numerous crops and is very persistent.**
- **Rule out humans as transmittors of infection.**
- **Reduce risks of contamination**
- **Reduce risk of contamination.**
- **Rule out humans as vectors.**

Motto all vegetative propagated production:



ATD

Attention **T**o **D**etail

Or:

- pay attention to small issues,
- take direct actions to be able to
- control and limit the consequences.

Tomato Spotted Wilt Virus in Pelargonium peltatum

Differences between bacterial and fungal leaf spots

- Bacterial leaf spots are:
  - water-soaked or oil-like irregular lesions commonly surrounded by a yellow rim
  - soft rot

- Fungal leaf spots are:
  - brown, yellow, black or purple with yellow rim
  - fungal growth is visible in the center of the spot on the surface OR undersurface of the leaf.
  - usually dry spots

Bacterial leaf spot

- *Pseudomonas*, *Xanthomonas*, *Ralstonia, Erwinia*
  - Bacteria are one cell organisms surrounded by a proper cell wall.
  - Multiplication through division of the cell.
  - When circumstances are right: each hour doubling of cells.

- Conditions for infestation:
  - weakened plant or plant with wounds
  - high humidity and free water for spread
  - minimum temperature of 18ºC. (aggressive in hot weather)

Bacterial infection

Pelargonium infected by

Xanthomonas

Bacterial infection **Ralstonia**

Difference with Xanthomonas is ????

Both are very dangerous.

Bacterial infection

- Cultural control
  - healthy origin and hygiene = keep crop clean
  - disinfection of floor/ tables/ equipment
  - in greenhouse: lower temperature.
  - remove infected plants and plants around
  - disinfection
  - remove recycling water
  - keep the plants / leaves dry.

- Chemical control
  - not possible
  - copper hydroxide may help to avoid spread

Botrytis

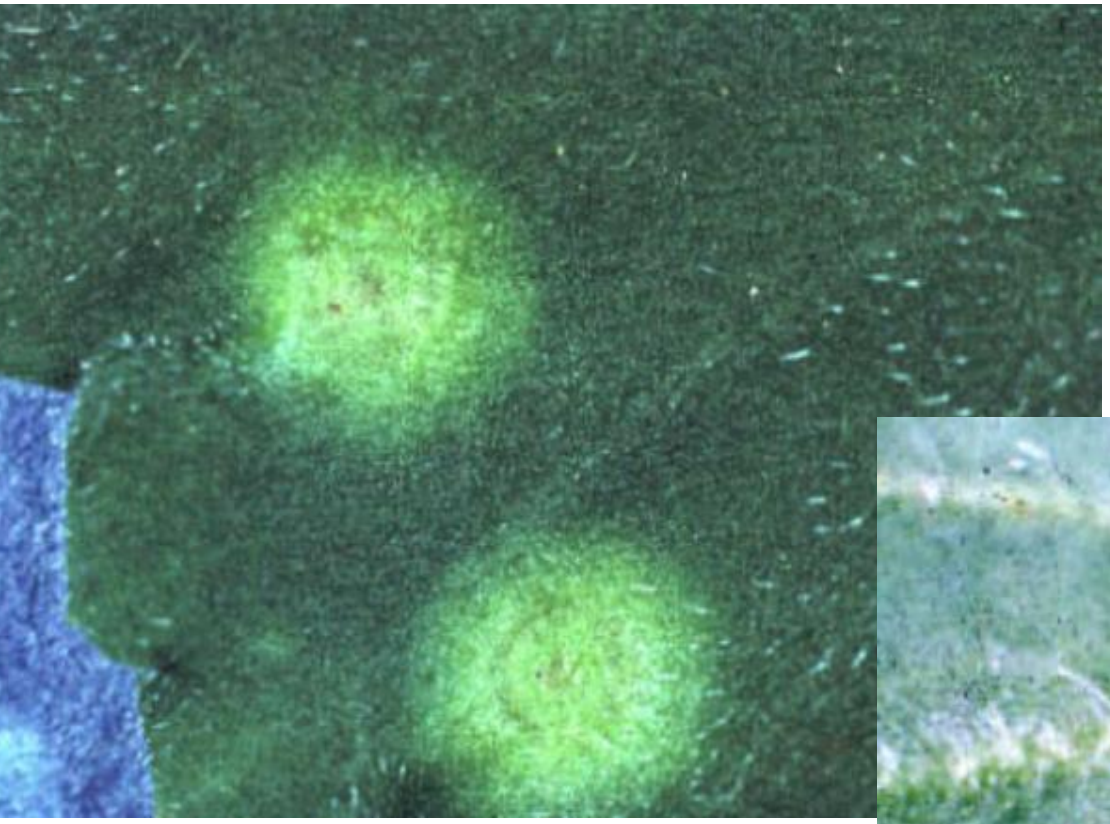
- Dusty, gray-brown fungal growth.
- Very common, wide spread fungus attacking plants when growing in sub-optimal conditions.
- Spread through splash and air.
- Survival in old tissue and in sclerotia (resting structures of the fungus).
- Conditions: leaf wetness period of 8 hours or a RH larger than 93% => germinating and infecting spores. In favorable conditions: every 4 days new lesions.

Botrytis

- Cultural control:
  - avoid long periods of wet leaves by watering well before the evening.
  - spacing of plants
  - ventilation
  - hygiene
  - right fertilization

- Chemical control:
  - numerous fungicides are available
  - rule: alternate fungicides to prevent build up of resistance.

Puccinia (Rust),



First phase

Second phase underneath

prime genetics

Puccinia (Rust),

- Within 7 days after infection first symptoms can occur, after 13 days first pustules arise.
- Severely infected leaves become yellow and drop prematurely.
- Free water is necessary for germination of spores.
- Temperatures of 16-21°C are optimum.
- Spores are spread by splashing water, air currents and people handling and moving the plants.

Control:

- By careful irrigation and air circulation to maintain dry leaf surfaces
- Use drip irrigation rather than over head watering
- If infected plants are found throw them away immediately

Other problems that mimic diseases f.i. Oedema

- Lack of water
- wilting
- marginal burning as result of temporary water stress

- Water surplus
- lack of oxygen
- poor root development.
- At low light intensity and poor air circulation:

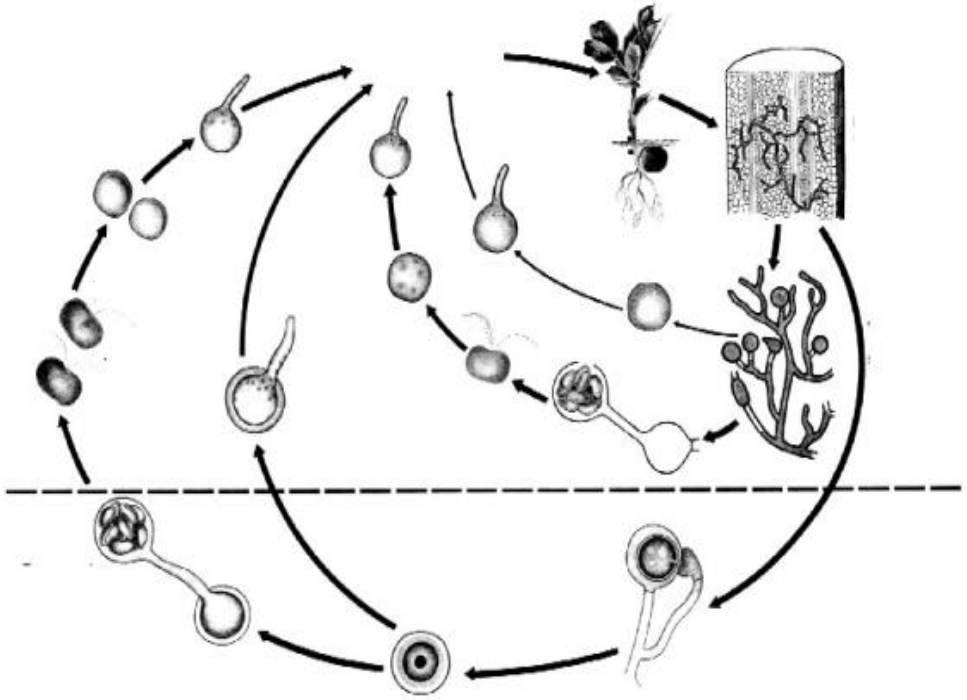
  oedema (blown plant cells visible as scab like spots, no recovery)

- OEDEMA is physiological stress.

Sunburned leaf edges. Water transport problem.

Soil diseases: Pythium & Phytophthora

- Fungi with similar habit.
- Need free water for swimming spores.
- Both fungi have resting spores.
- Resting spores can survive for years in soil.



Life cycle of Pythium or Phytophthora

- Conditions
  - Changing moisture
  - Free water available

Pythium & Phytophthora

- Brown root rot caused by too wet soil in combination with low temperatures

- Ridomil Gold M
- Previcur N
- Tattoo

Soil diseases: Pythium & Phytophthora

Pythium

- attacks poor growing crops
- fast decline caused by block of the root system
- related to the soil
- to establish: root core stays intact while the epidermis of the root is easily stripped off between your fingers

Phytophthora

- true parasite
- fast wilt due to invasion of the vascular system
- attacks roots, stems and leaves
- to establish: roots and stems are black. The main root breaks easily.

Wilts

- Wilts are spotted by a fading of color followed by yellowing.
- The cause can be:
  - a stem-rot at the plant basis
  - root-rot
  - block of veins
  - physiological stress (high salt, dry substrate,..)

- Wilting plants cannot be cured.

- Physiological stress is reversible in contrast to fungal or bacterial wilts !!!

Wilts: vein blocking

- Caused by:
  - Fungi: *Verticillium* and *Fusarium oxysporum*
  - Bacteria: *Xanthomonas*, *Erwinia* and *Pseudomonas*
  - Enters the plant through its roots (wounds) and spreads in the vascular system of the plant.
  - Browning of vascular system, leading to wilt of the whole plant or to certain parts of the plant.
  - Measurements: remove infected plants, good drainage and soil structure, correct fertilization of plants and rotation with non-susceptible species

Wilts: root- and stem rots

- Symptoms of roots and stem-base:
  - brown roots with white tips: *Thielaviopsis (Chalara)*
  - black, soft rot: *Pythium, Phythophthora*
  - brown (soft) rot: *Fusarium, Verticillium*
  - breaking off at soil surface: *Rhizoctonia*
  - stem base with “spiderweb”: *Sclerotinia*
  - smelly soft rot: *Erwinia*

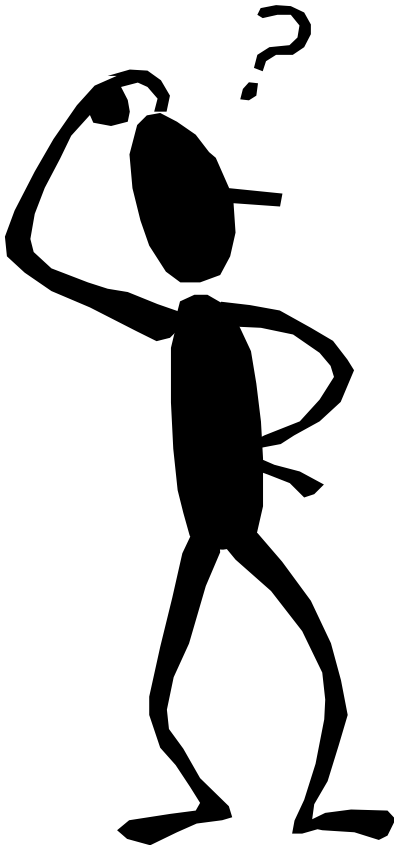
- Measurements: healthy plugs or cuttings, well-drained potting medium, balanced nutrition, avoid plant stress and overwatering.

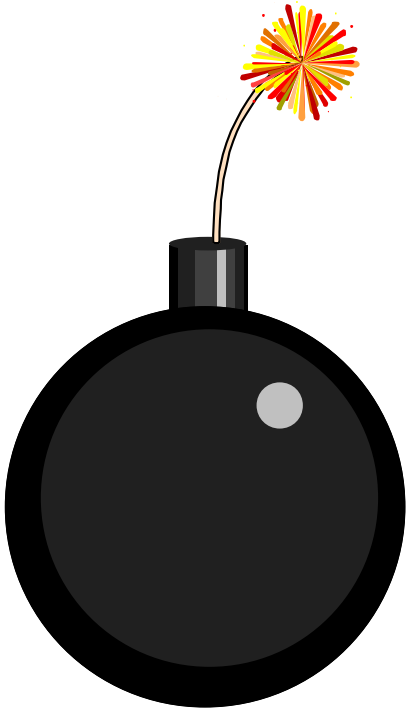
Footrot and fungal wilt

- Cultural control
  - correct balance of nutrients
  - remove infected plants
  - clean and disinfect surfaces (including with chemicals)

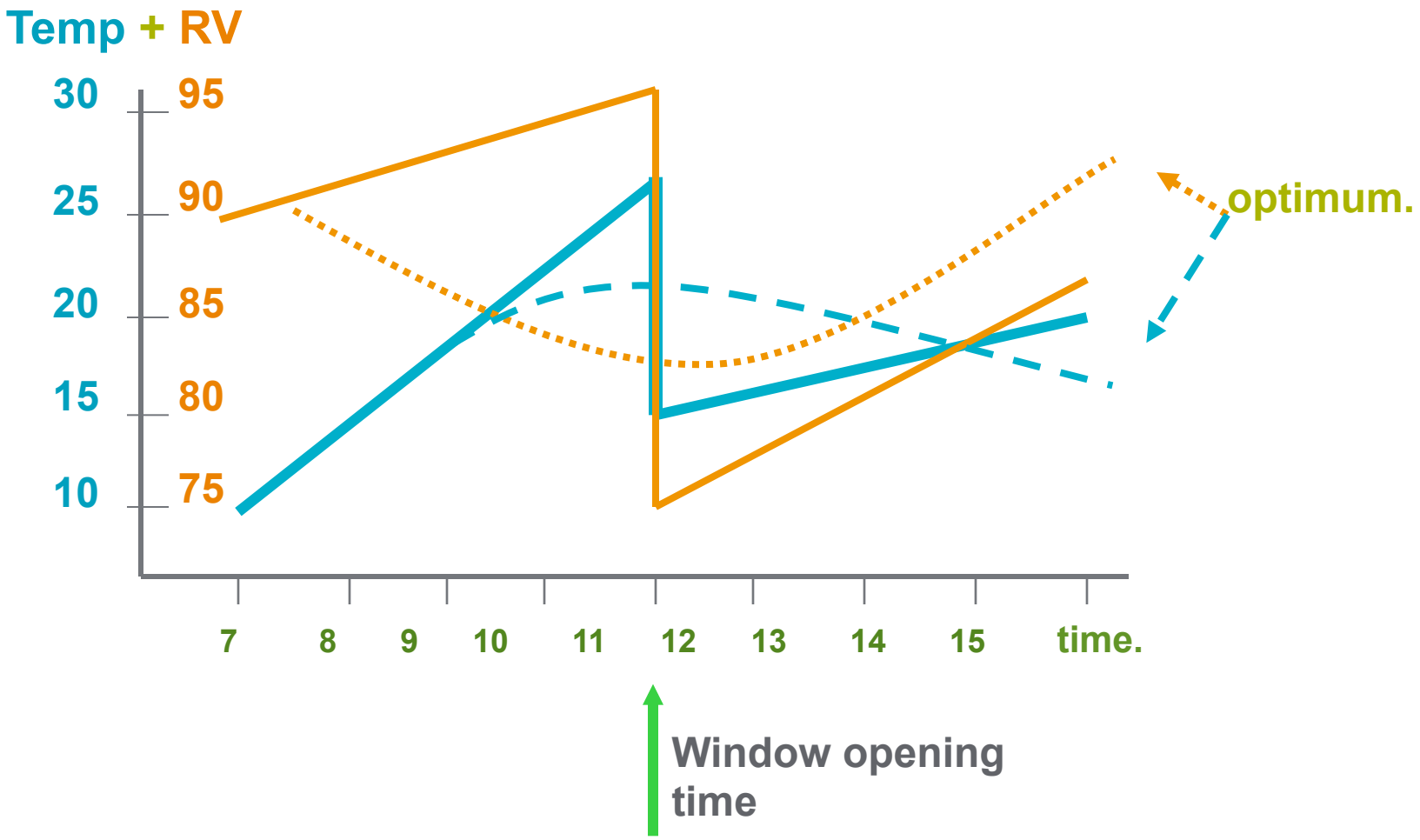
- Chemical control
  - a cure is not available, fungicides only reduces the growth of the fungus, no elimination.
  - Carbendazim
  - tolylfluanide
  - dithiocarbamate (especially for Myrothecium)

Is this your climate?





Dangerous actions in the morning



Climate rules

- don’t give too much water. (**look at daylength, temp. light intensity.)**
- try to grow as regularly as possible. **(like flying, or driving)**
- carry off always (high) humidity. Keep windows open.
- prevent big shakes in temp. RH and radiation. **(light intensity)**
- use heating system in time. Especially in spring nights.
- be aware of day and night differences.
- control climate between the plants.
- react proactive on weather changes.
- avoid problems by taking action immediately.

How to fight diseases in our crops:

- What does fungi need to start:
  - Spores or other sources of contamination.
  - Susceptible plants
  - High humidity

- Which action is the best to do: Success %
  - Remove all spores and avoid contamination (Hygiene) 10
  - Use the right chemicals against fungi 20
  - Increase plant quality (fertilizer and balance) 40
  - Control the climate (stability and active) 30

What to do? Prepare yourself

- Figure out your space! Look for ideal plant distance = quality
- Clean your benches, including ground level and working area
- Remove weeds in- and outside the greenhouse
- Disinfection of the greenhouses always recommended
  - Especially recommended when you got a disease in the crop before
- Make sure that plants are transplanted in time, or treat them specific during the plug phase. (no plain water)
- *Impact of last season? Left over plants, own production?*

Stress increases the chance of infection

Avoid stress, avoid diseases

Spray damage from growth retardants.

General conclusion growth retardants:

- **The less the better.**
- **A problem solved for the grower is quite easily a problem made for the consumer.**

- Florel (Ethephon) helps maintain compactness and smaller leaves, but will delay flowering, and gives flower bud abortion.

Bonzi trial at Calliope Dark Red Drench

- 0.25 ppm Bonzi drench for Calliope Dark Red once you get close to salable size (or to hold)
- Don’t go much higher
- Geraniums are very sensitive to Bonzi drenches

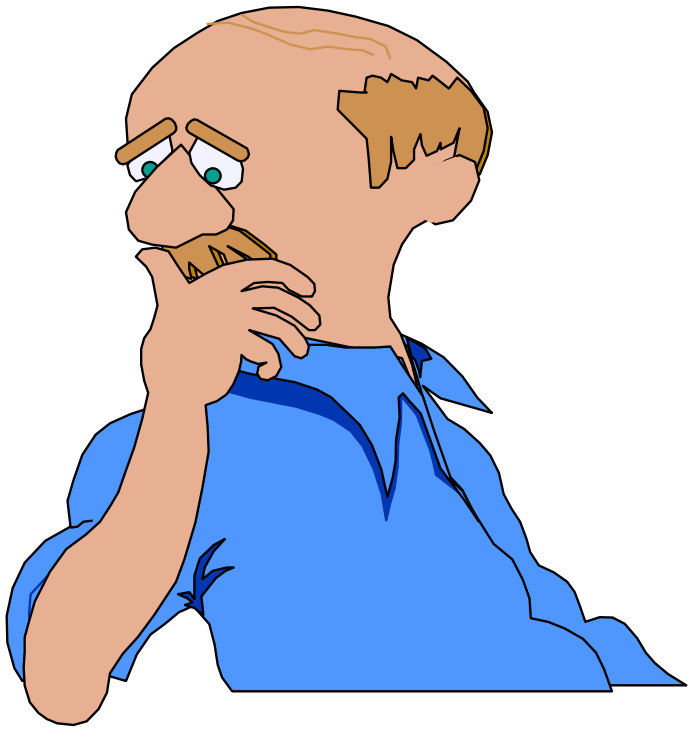
Calientes Avoid Bonzi Drenches

Control1 Control2 0.25 ppm 0.5 ppm 1.0 ppm

Bonzi Drench Rate

Composition and ratio of the dry substance of plants

N	Nitrogen	1.000.000
K	Potassium	250.000
Ca	Calcium	125.000
P	Phosphorus	60.000
Mg	Magnesium	60.000
S	Sulfur	30.000
B	Boron	2.000
Fe	Iron	2.000
Mn	Manganese	1.000
Zn	Zink	300
Cu	Copper	100
Mo	Molybdenium	1



Example of Schedule for A+B tank system

Drip EC:	2.0	Grower:	Sittig	19-Feb-14
Tank size (Litres):	1000	Country:	South Africa	
Concentration:	100%	Culture:	Pelargonium	
Water from well:	0%	Soil analysis:	No	
Ureum:	0%	Advice:	standard whole culture	
Potas. Phosphite Y/N:		Water:	Rainwater	
P2O5 +/- :	100%			
SO4 +/- :	100%	Schedule:	F 17 - Mums/Pelargo gen. (gr4gen)	FroriPro services™
NH4 /- :	80%			

	1000 litre A			Tank composition		1000 litre B	
Calcium Nitrate (sol)		74.9	Kg.	Nitric Acid	60%	----	L.
Ammoniumnitrate (liq)	18.0%	4.7	L.	Phosphoric Acid	59%	----	L.
Potassiumnitrate		16.8	Kg	Potassiumnitrate		37.1	Kg.
Nitric Acid	60%	----	L.	Mono Potassium Phosphate		18.1	Kg.
Magnesiumnitrate (liq)		----	L.	Magnesium Sulphate		32.9	Kg.
Ureum		----	Kg.	Potassium Sulphate		17.4	Kg.
Calcium Chloride		----	Kg.				
		97.5	Kg.			105.6	Kg.
Fe. DTPA (sol)	11.6%	1175	Gr.	Manganese Sulphate (Sol)		85	Gr.
				Zinc Sulphate (sol)		81	Gr.
% Calcium Nitrate kg`s		*37%*		Borax (sol)		190	Gr.
% Magnesium Sulfaat kg`s		*16%*		Copper Sulphate 25% (sol)		13	Gr.
% Potassium Sulfaat kg`s		*9%*		Sodium Molybdate (sol)		12	Gr.
HCO3 buffer mmol		*0.00*					

	Balance:	N	P	K	Mg	Ca	
		1	0.49	2.1	0.27	1.0	

What is this? Necrotic tissue.

- **Wrong fertilizer**
- **System out of order**

1- mottling of the leaves, destruction of the zone

2- 1st stage of necrotic tissue

3- 2nd stage of necrotic tissue one week later

prime genetics

syngenta

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Calientes

Iron deficiency (tip yellowing)

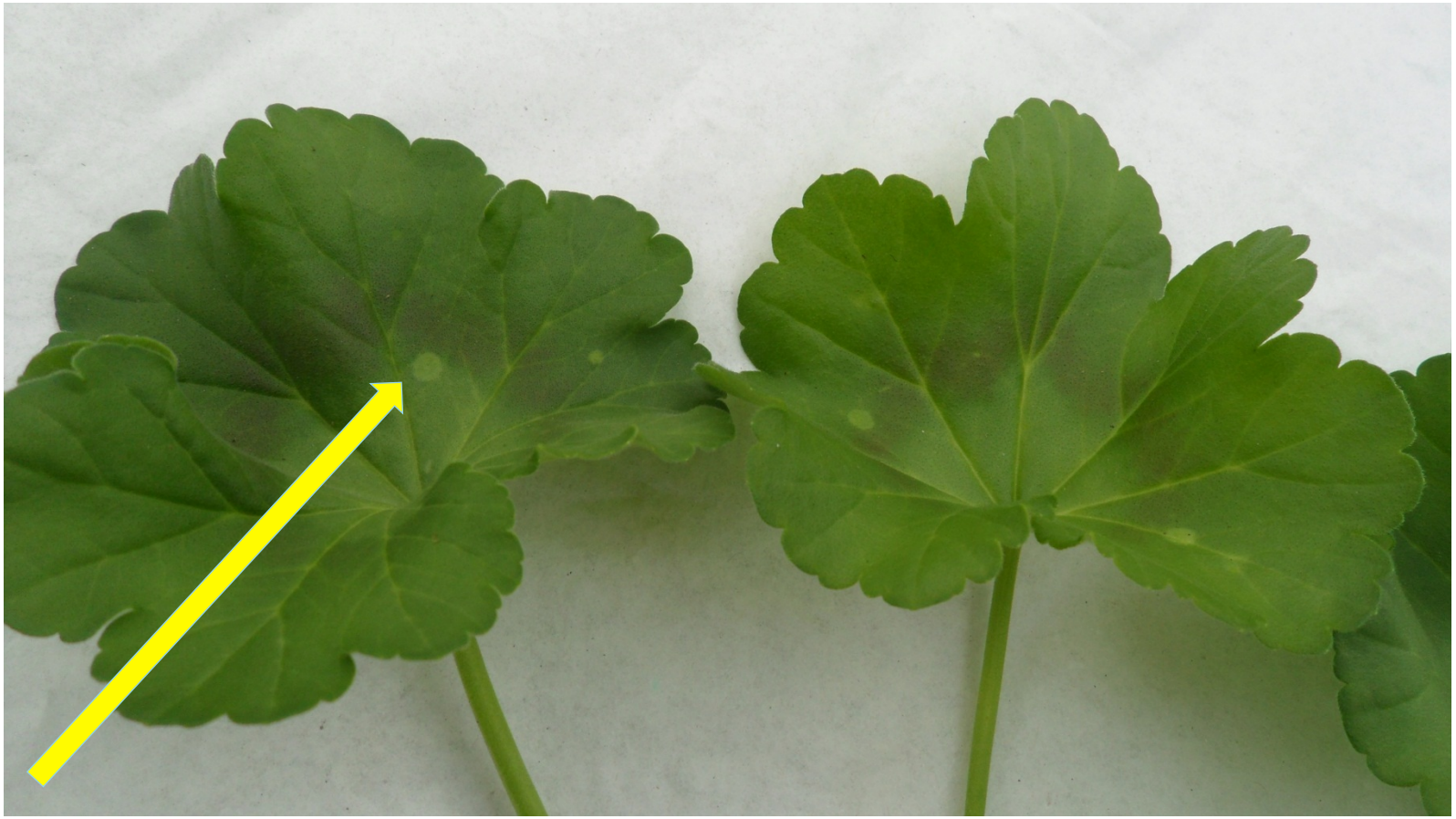
- Calientes tend to be more resistant to “tip yellowing” compared to regular ivy geraniums
- However, we have seen symptoms under extremely high temperature stress and high pH in Lavender and Deep Red
- Keep the pH between 5.5 - 6.0 and reduce extreme heat stress to help avoid tip yellowing
- Adapt fertilizer schedule in case iron level is too low.

Too big and open plant habit.

Calliope Dark Red

- **Too less EC**
- **Poor spacing**

What is this? First signs of Botrytis



Progression of the symptoms

- **Ultimately the entire production ruin.**

(flowers do not seem to be affected)

What is this?

- **Xanthomonas**

- **CCC damage**

Coryne bacterium

- Mostly quite local.
- Disinfect tables and floors
- Not very infectious

What is this?

- Lack of SO_4

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What is this?

- **Low EC start culture / badly build leaves**

- **Virus How do you know?**

What is this?

- **Motherstock quality.**
- Underfertilised, out of season etc.

What is this?

- **Starving – no food at all**

To late start of fertilization. Pot is empty.

What is this?

- Minor elements
- Boron
- **pH problem**
- Water quality

What is this?

- **Root problem**

  (overwatering)

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What is this?

- Iron problem, because of low Temperature

Finally…

Quality is never an accident, but will only be born after hard and clever work.

Thank you for your attention

Dankie vir jou aandag.