Let's improve together.

# TomatoesNZ conference

New Zealand

**08 August 2024**

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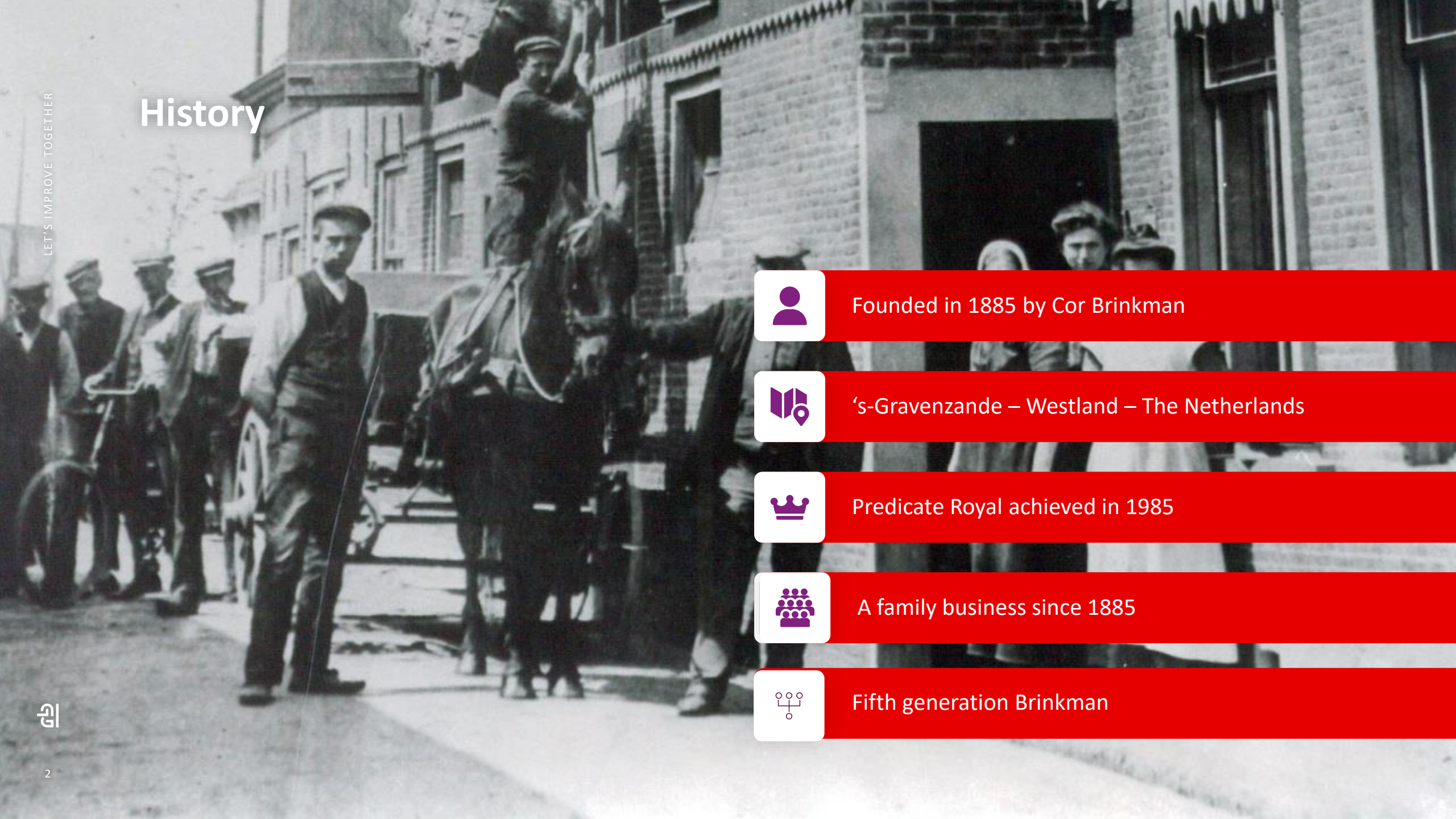
global specialist in horticulture

# History



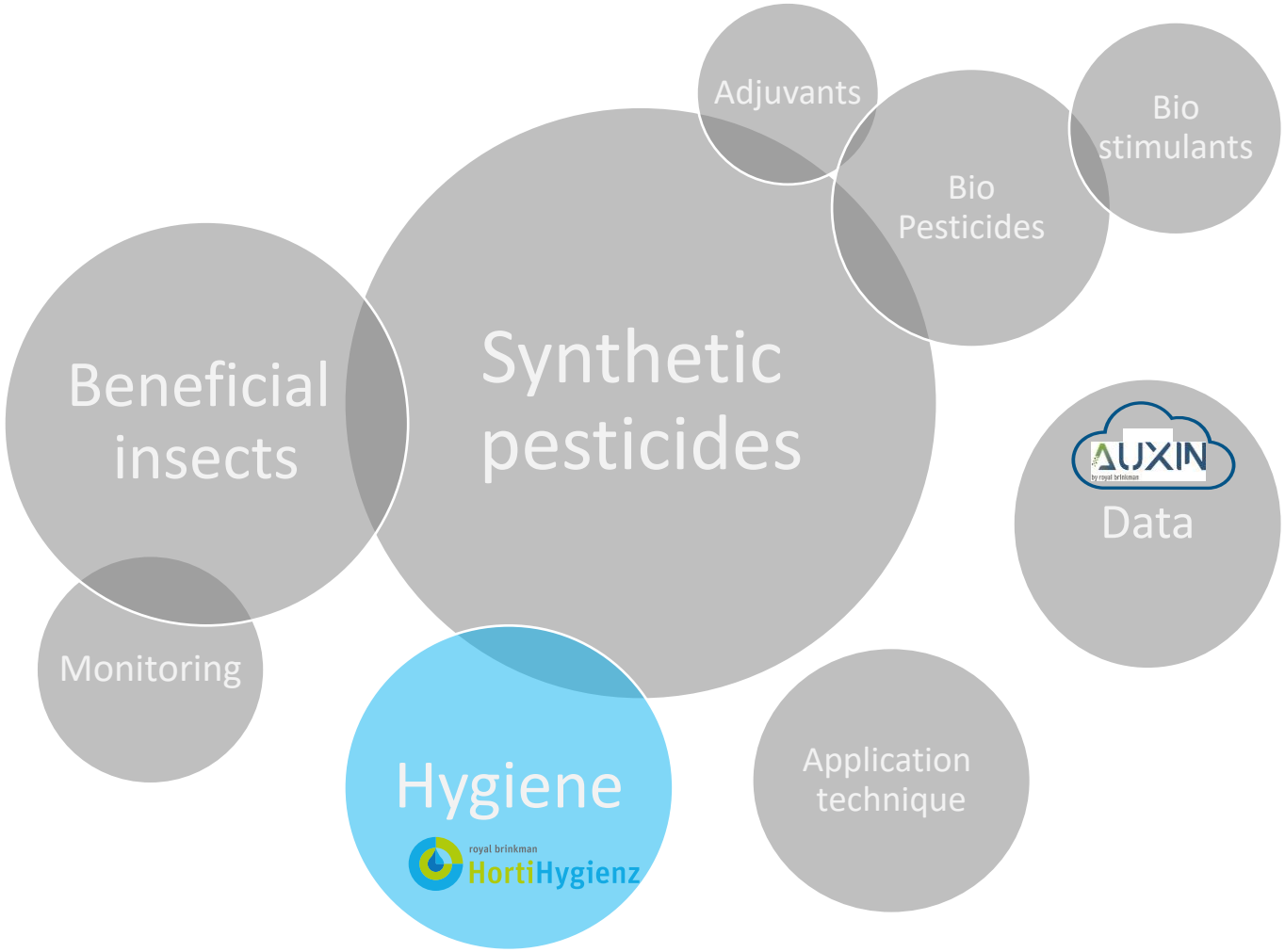
- Founded in 1885 by Cor Brinkman
- ‘s-Gravenzande – Westland – The Netherlands
- Predicate Royal achieved in 1985
- A family business since 1885
- Fifth generation Brinkman

- Branches in 15 countries
- Active customer approach >100 countries


2024

2030

The move to **Prevention & prediction**



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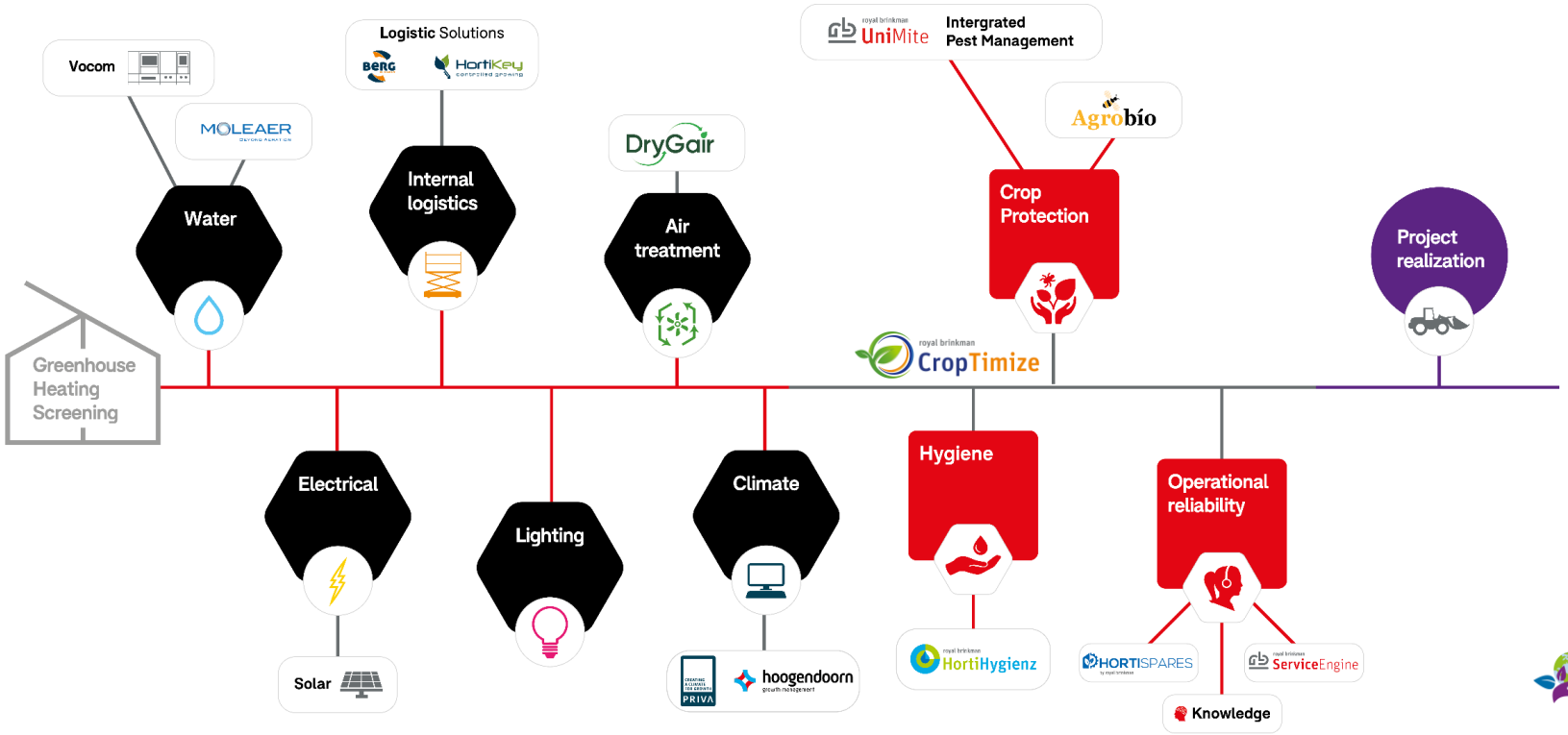


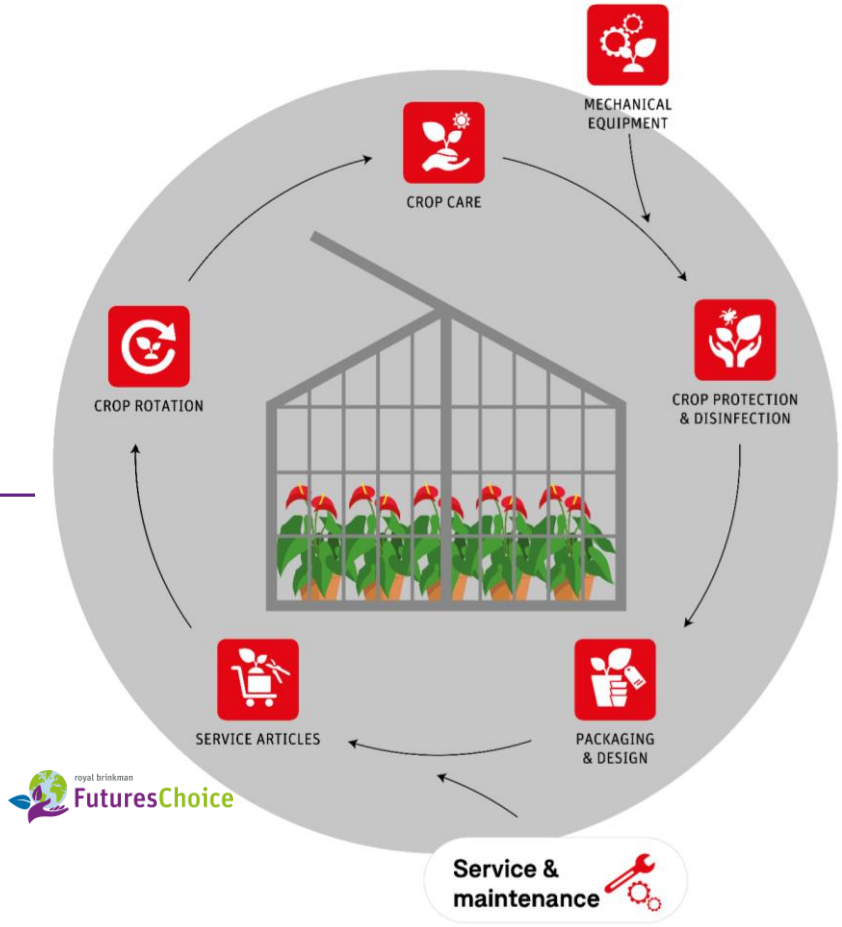

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# Best practice hygiene management in horticulture

## Inspiration & knowledge session

Jasper Verhoeven
Product specialist hygiene & disinfection

**08 August 2024**
**South Auckland**

royal brinkman
global specialist in horticulture

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**HELLO,** I AM

# Jasper Verhoeven

Product Specialist Hygiene & disinfection

Knowledge & advice

Product-solutions

Technical applications

Research & innovation

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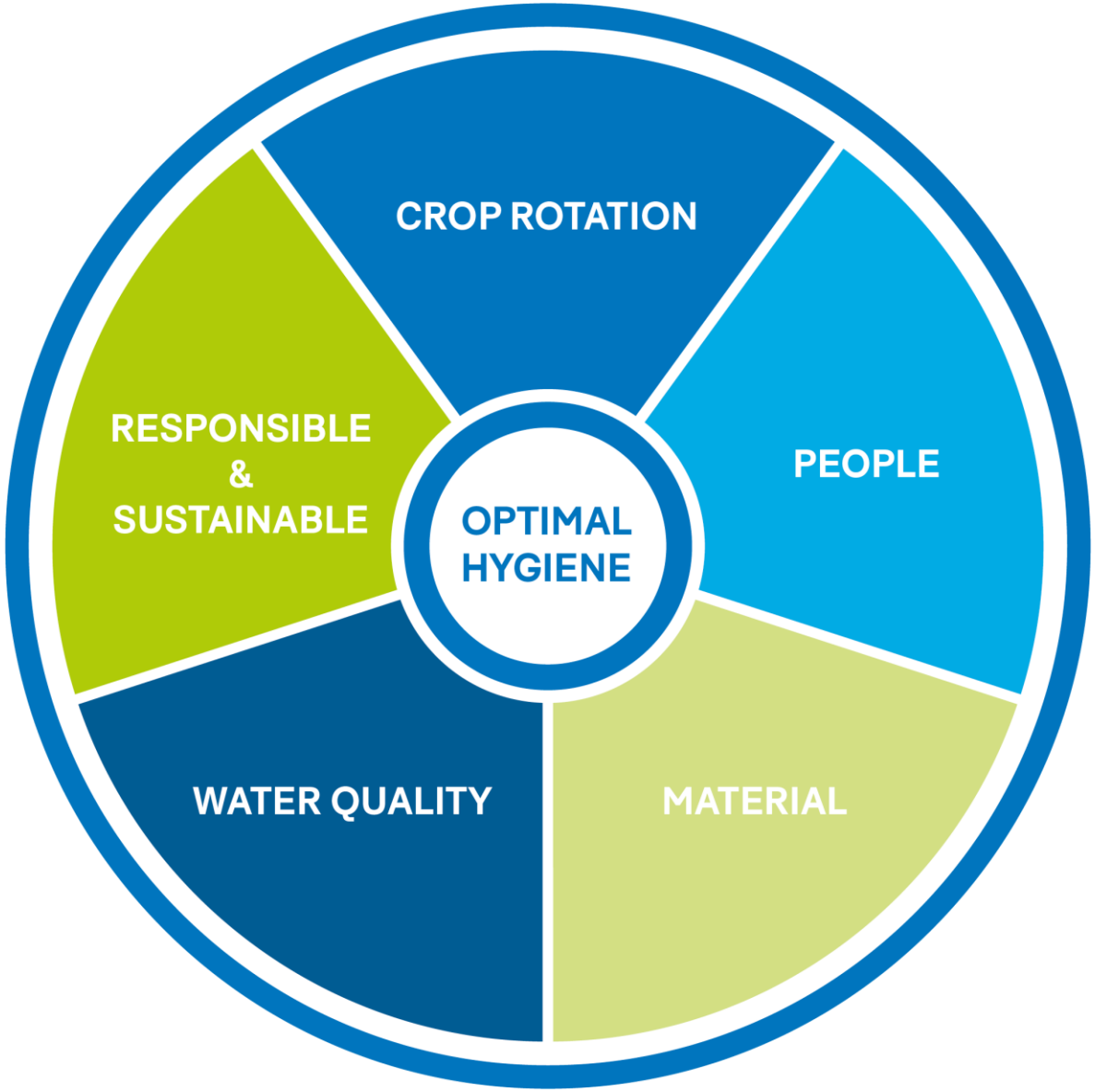
# HortiHygienz

The answer to reduce the level of diseases on horticultural farms in vegetable and ornamental horticulture



# Hygiene as a system

HortiHygienz | Introductie - YouTube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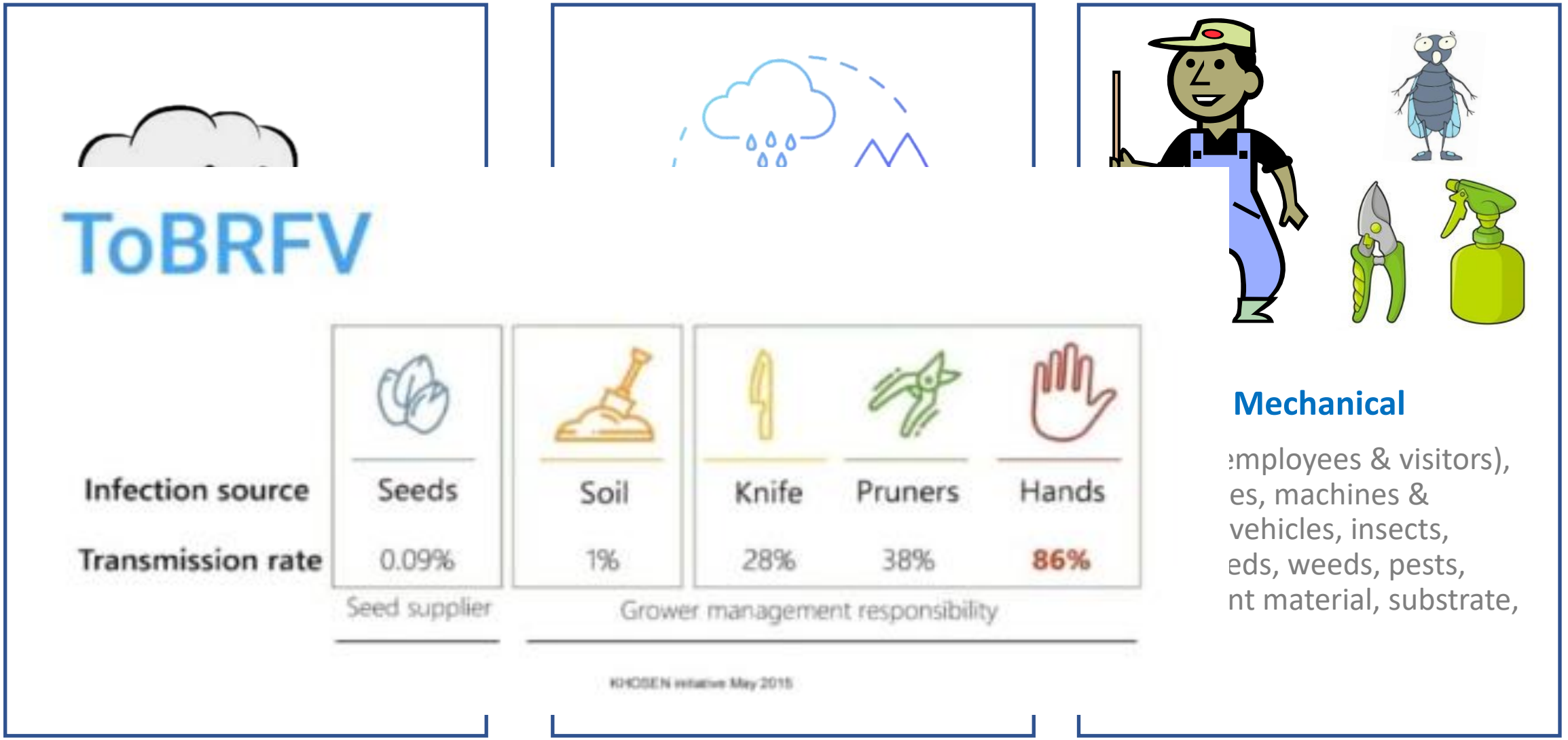
# How pathogens can be spread




## Mechanical

employees & visitors),
es, machines &
vehicles, insects,
eds, weeds, pests,
nt material, substrate,

sleeping area tested. In particular, the pillows were frequently contaminated (10 out of 42 ToBRFV-positive samples), as was the mattress cover, with two out of 10 samples testing positive. The plant virus was even detected in parts of the foam mattress (Figure 7).

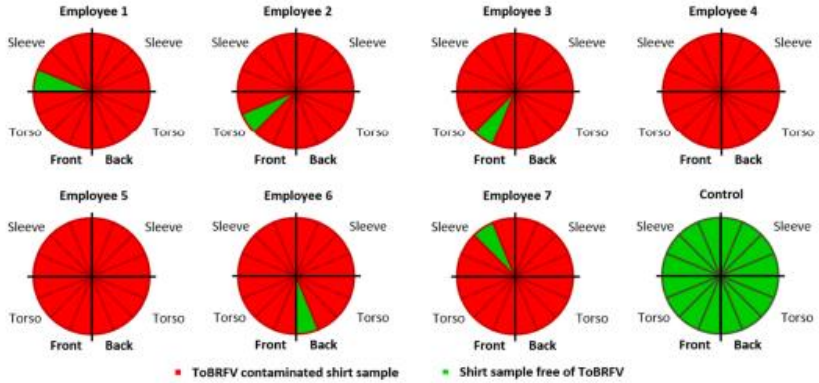



**Figure 5.** Proportion of 16 ToBRFV-contaminated and non-contaminated subsamples of each T-shirt worn by an employee for one day in a ToBRFV-infested greenhouse determined by mechanical inoculation of the indicator plant *Nicotiana tabacum* cv. Xanthi NN with fabric subsamples.

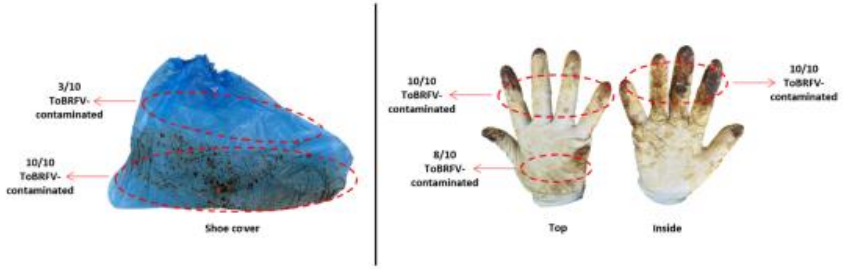
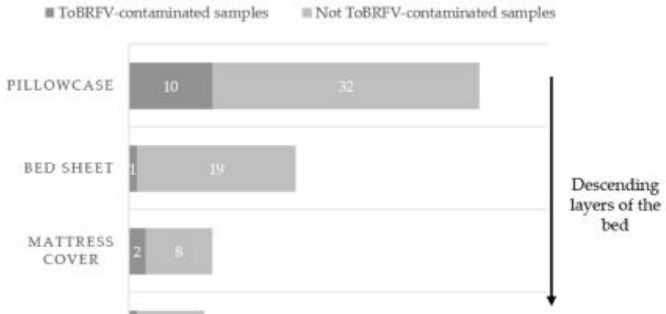



**Figure 6.** Proportion of ToBRFV-contaminated samples taken from different protective items wo for one day in a ToBRFV-infested greenhouse determined by mechanical inoculation of the indicat plant *Nicotiana tabacum* cv. Xanthi NN.




### 3.2. Frequency of ToBRFV-Contamination on Surfaces in Different Farm Locations

The presence of dried plant sap, green to brown in color, on tested surfaces was only a limited indicator for the presence of ToBRFV contamination in the sampled tomato farm (Figures 3 and 4). We used Fisher's exact test to determine whether the ratio of ToBRFV-contaminated to non-contaminated surfaces could be inferred from a visible plant sap stain. In fact, 46 of 70 (65.7%) samples taken from the tomato production-related areas of greenhouses, packaging and office areas, and farm vehicles were contaminated with ToBRFV, although they displayed visible plant sap contamination during sampling. However, it was found that 19.8% (23 of 116) of the sampled surfaces in these areas with no visible plant sap residue were contaminated with enough virus to cause infection of the test plants.


**Figure 3.** Objects and surfaces from which swab samples were taken for possible contamination with ToBRFV. '(**A**)' = hand rail; '(**B**)' = door handle; '(**C**)' = green sap stained wall; '(**D**)' = light switch; '(**E**)' = kettle; '(**F**)' = cabinet handle; '(**G**)' = foot mat; '(**H**)' = trolley; '(**I**)' = pipe; '(**J**)' = foil; '(**K**)' = controls of lift truck; and '(**L**)' = lift truck.

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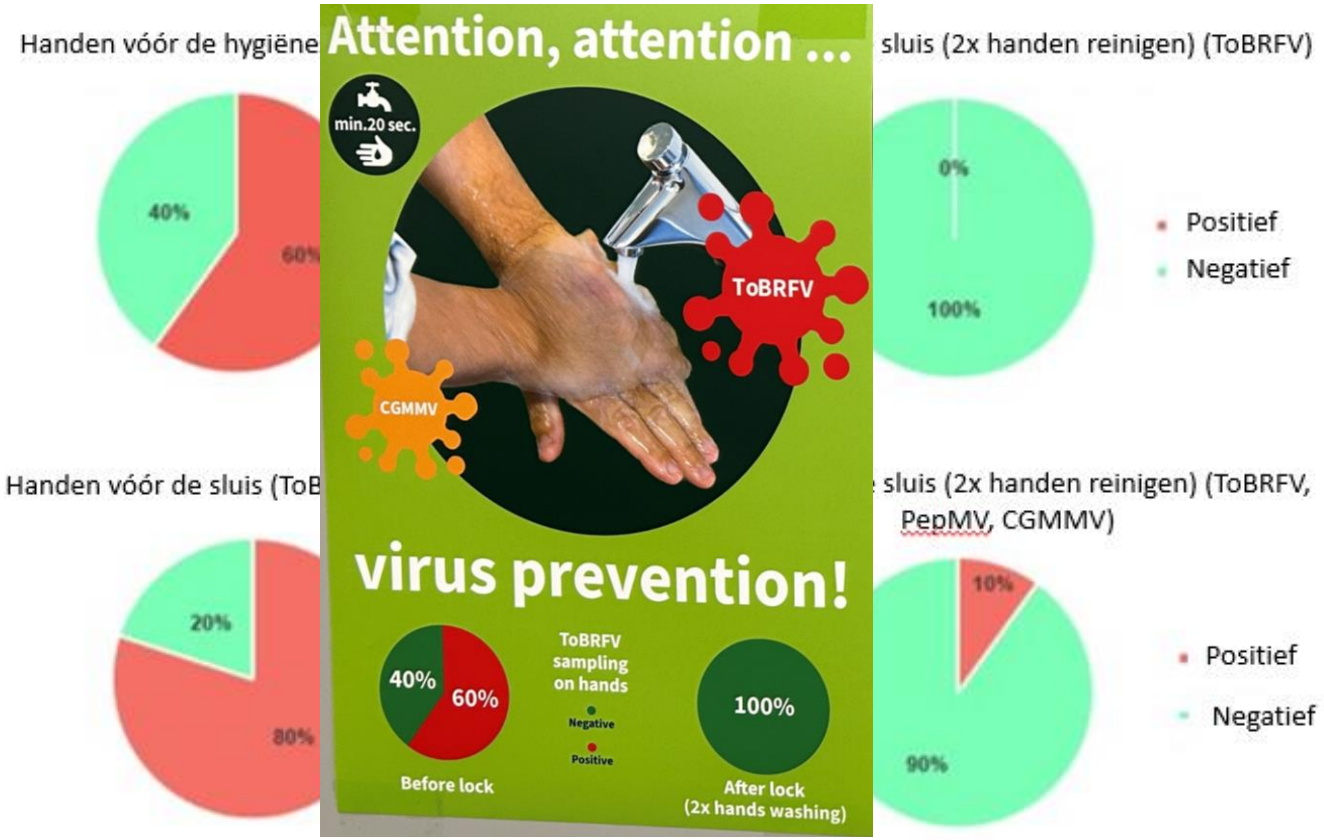
# Carefull washing hands is crucially important

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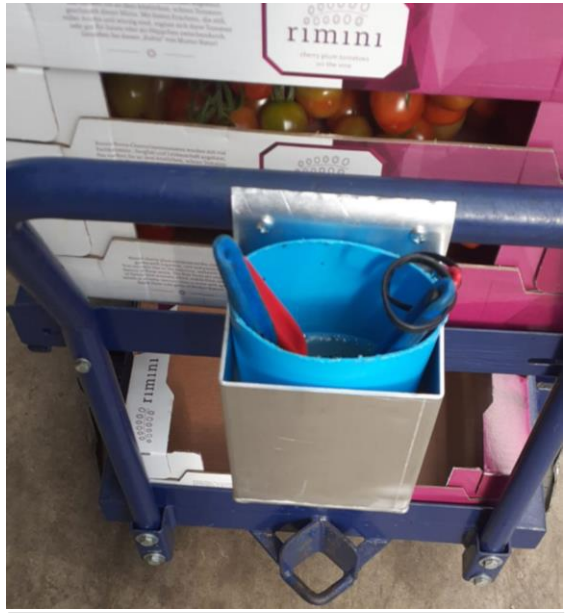
# Fadex Rapid

- For hands/ gloves and tools
- Without alcohol
- Measureable


ToBRFV, Fusarium, Clavibacter

➢ 30 seconds

➢ pH<3,5

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# Test results handcleaner Fadex Rapid against ToBRFV

Normec
Groen Agro Control

***Table 2.*** *Test results of treatments with undiluted FADEX Rapid on ToBRFV-contaminated hands and nitril gloves. Scores are expressed as number of ToBRFV-positive plants out of four repetitions per treatment.*

| Product | Contact time | Results bio-assay (number of plants infected with ToBRFV/number of inoculated plants) | |
|---|---|---|---|
| | | Hands | Nitril gloves |
| no | - | 4/4 | 4/4 |
| water | 3 min | 2/4 | 2/4 |
| FADEX Rapid | 30 sec | 0/4 | 0/4 |
| FADEX Rapid | 1 min | 0/4 | 0/4 |
| FADEX Rapid | 3 min | 0/4 | 0/4 |


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# Application of the Surface coating by Berg Hortimotive


# Makes cleaning much easier and faster to do

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# Greenhouse Glass Clean

**Ecological** cleaning agent for (AR) glass & foil

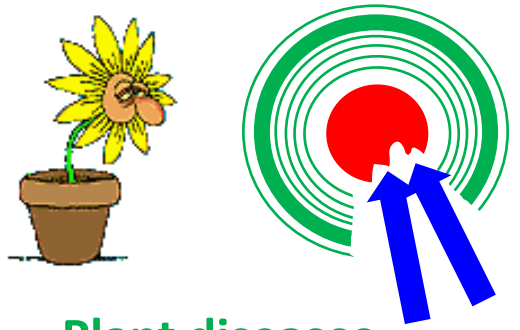
- No personal protective equipment necessary
- No vapor effect
- Safe on all glass (and plastic) surfaces; no etching effect suitable for cleaning **diffuse and AR-coated** glass
- Strong descaling and cleaning effect, allowing removal of algae, moss, green deposits, and mineral contaminants
- 100% organic and completely degraded after 28 days
- No ADR classification; no restrictions for storage and transport
- Can be applied as foam; provides a longer action and better contact.

# Biocide OR Plant Protection Product

animals / humane diseases

↓

Biocide



Plant diseases

↓

Plant Protection Products

## Various legislations

**Plant Protection Product (PPP)**

**Biocides**

**Product without registration**

# WUR research: Cucumber Green Mottle Mosaic Virus

Effectiviteit van Menno florades op komkommerbontvirus

Vertrouwelijk verslag

Ineke Stijger en Roel Hamelink

Wageningen UR Glastuinbouw

november 2007

26-09-07

Meting pH van de diverse concentraties Menno florades.

| conc (%) | pH |
|---|---|
| 1 | 2.5 |
| 2 | 2.38 |
| 3 | 2.3 |
| 4 | 2.24 |

| herhaling | | 1 | | | 2 | | | 3 | | | 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | plant | | | plant | | | plant | | | plant | | |
| conc (%) | inwerktijd (uur) | 1 | 2 | ELISA | 1 | 2 | ELISA | 1 | 2 | ELISA | 1 | 2 | ELISA |
| 1 | 1 | +[2)] | +[2)] | nt | - | - | - | + | - | nt | +[2)] | - | nt |
| | 4 | +[2)] | - | nt | +[2)] | - | nt | - | - | + | +/-[1)] | +[1)] | nt |
| | 8 | - | - | - | - | - | - | +[2)] | - | nt | - | - | - |
| | 16 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 1 | - | - | - | +/-[1)] | +[1)] | nt | - | - | - | - | - | - |
| | 4 | - | - | - | - | - | + | +[1)] | +/-[1)] | nt | - | - | - |
| | 8 | - | - | - | - | - | - | +[2)] | - | nt | - | - | - |
| | 16 | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 4 | +[2)] | - | nt | - | - | - | - | - | - | - | - | - |
| | 8 | +[1)] | +[2)] | nt | +[2)] | - | nt | - | +[1)] | nt | +/-[1)] | +[2)] | nt |
| | 16 | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 4 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 16 | - | - | - | - | - | - | - | - | - | - | - | - |

\- geen symptomen (bij ELISA test, geen virus aangetoond)

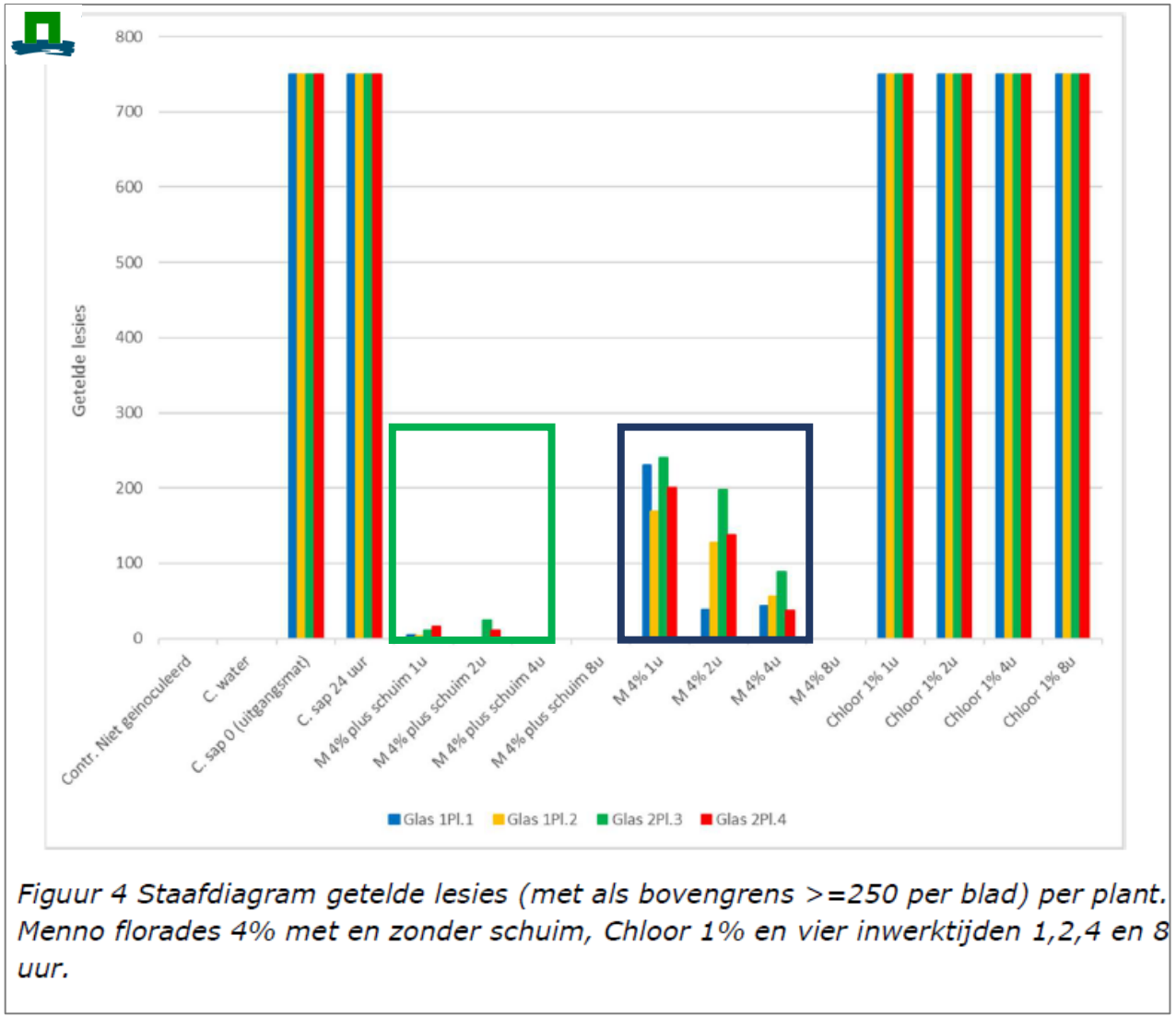
+/- beginnende symptomen

\+ symptomen aanwezig (bij ELISA test, virus aanwezig)

# WUR - research ToBRFV

## Foam is more effective than spraying.

" foaming application makes a disinfectants working faster"




*Figuur 4 Staafdiagram getelde lesies (met als bovengrens >=250 per blad) per plant. Menno florades 4% met en zonder schuim, Chloor 1% en vier inwerktijden 1,2,4 en 8 uur.*

Effect within the first hour:
Foaming → 95% effect
Spraying → 75% effect

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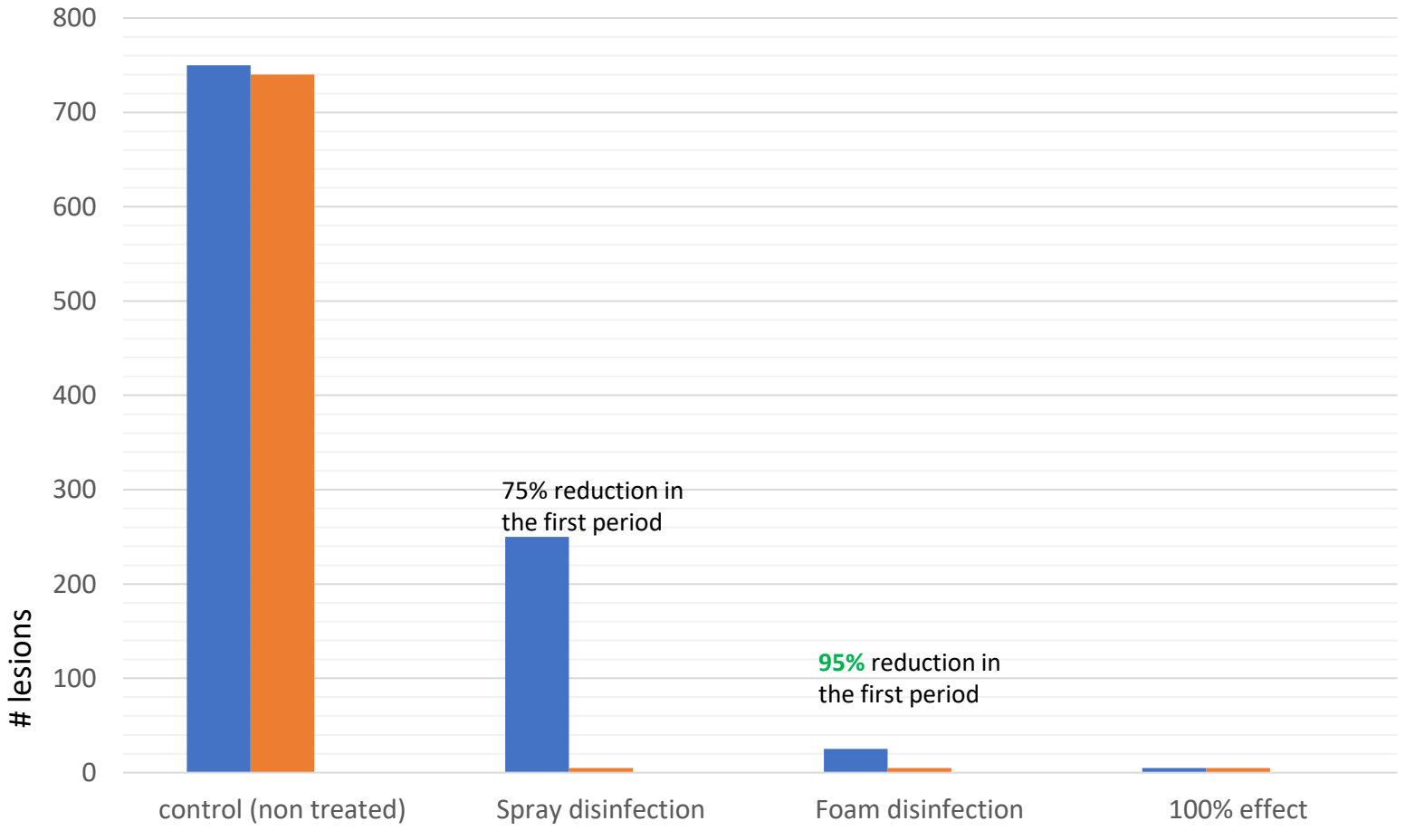
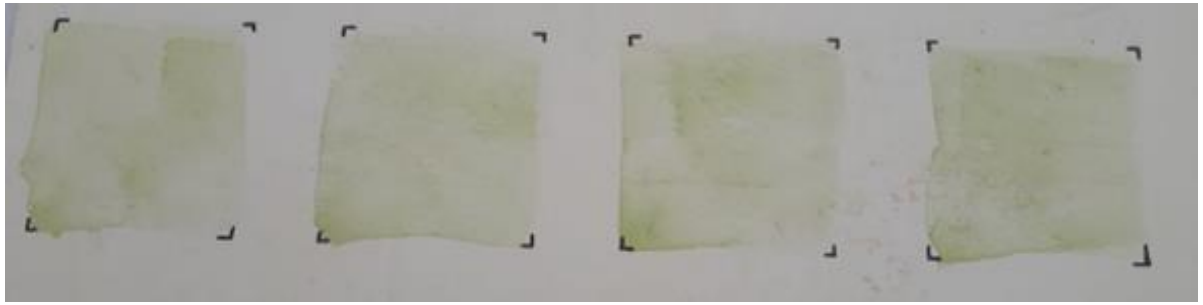
# spraying versus foaming treatment

## based on the number of virus lesions




# GAC research: ToBRFV



Metal gutters and glass with ToBRFV infected dried plantjuices

*Table 2. Test results of treatments with 4% MENNO Florades on ToBRFV-contaminated cultivation gutters and glass plates. Scores are expressed in amount of ToBRFV-positive (+) plants out of 4 repetitions per treatment.*

| Nr. | Material | Product | Dosage | Contact time | Amount of ToBRFV + plants / 4 plants |
|---|---|---|---|---|---|
| 1 | Metal gutter | No | - | - | 4 / 4 |
| 2 | Metal gutter | Water | - | 5 min. | 4 / 4 |
| 3 | Metal gutter | MENNO Florades | 4% | 4 hr. | 0 / 4 |
| 4 | Metal gutter | MENNO Florades | 4% | 16 hr. | 0 / 4 |
| 5 | Glass plate | No | - | - | 4 / 4 |
| 6 | Glass plate | Water | - | 5 min. | 3 / 4 |
| 7 | Glass plate | MENNO Florades | 4% | 4 hr. | 0 / 4 |
| 8 | Glass plate | MENNO Florades | 4% | 16 hr. | 0 / 4 |

**CONCLUSION**

MENNO Florades can effectively disinfect horizontal metal cultivation gutters and vertical glass plates, which are contaminated with ToBRFV-infected plant sap, with a dosage of 4% and contact times of 4 and 16 hours.

The conditions during the treatments were as follows:

- The product is diluted to 4% in demineralised water
- pH of the solution was 2,72
- EC of the solution was 2,43
- Used amount of liquid was 700-800 mL/m$^2$
- After wetting the horizontal gutter, the first somewhat dry spots on the treated surface were observed 45 min. later. After 1 hour the gutter was almost completely dry, but some thin film was still visible. After 3 hours it was completely dry.
- The wetted vertical glass plate looked after 15 min. visually dry.

So…, contact time is not the same as the time a surface seems to be wet!!

# Foam is more effective then spraying

" surface stays wet longer"

**contacttime** is NOT the same as the time a surface should be **WET** !!

## 1 hour


## 2 hour


## 4 hour

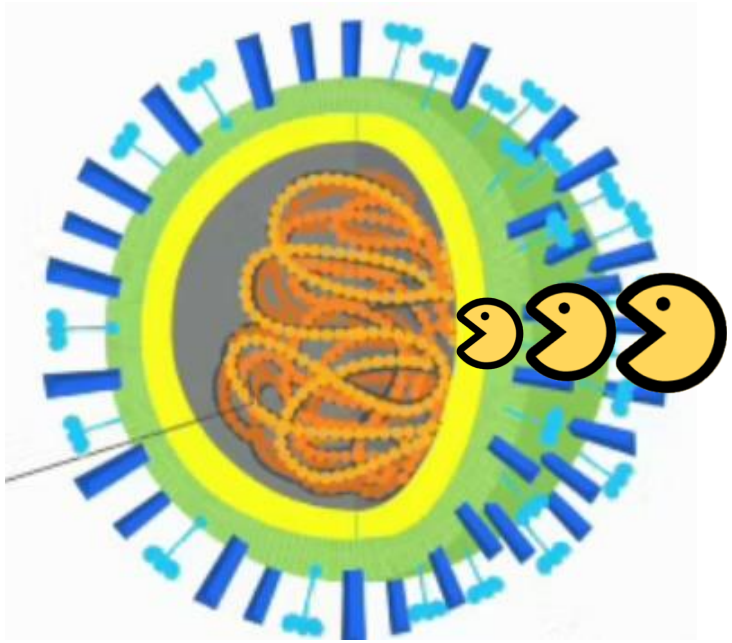
= optimal effect

= diminishing

= no effect

| | Contact time: 0 – 30 m | 30 – 60 m | 2 – 6,5 h | 11 – 15 h | 15 – 16h |
|---|---|---|---|---|---|
| | Algae  | Bacteria  | Fungi  | Viruses  | Fungal spores  |
| Quats | | | | | |
| Formalin | | | | | |
| Chlorine | | | | | |
| Hydrogen peroxide | | | | | |
| Pentapotassium | | | | | |
| Benzoic acid | | | | | |

# Unstable/ corrosive (fast action) disinfectants



**Dried = end of action**

Examples oxidators:

- Chlorine/bleach products
- Jet 5
- Virkon S
- Virocid
- Soda
- Peroxide

# Attention points ToBRFV research:

## corrosivity of products is not preferred to fight viruses

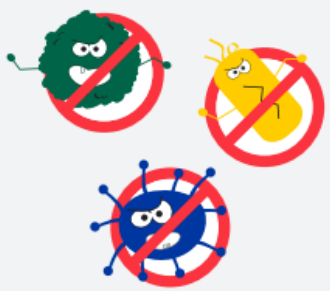
- Dirty or rusty objects are not good to disinfect (remind materials also need cleaned/ disinfected good & easy in the future)
- Always clean before you disinfect!


# Menno

## Special for Horticulture

:

| Bacteriën | Schimmels (incl. rustsporen) | Virussen/Viroïden |
|---|---|---|
| Acidovorax avenae ssp. cattleyae*[1] | Alternaria alternata*[10] | ArMV*[2/22] (arabis mosaic nepovirus) |
| Agrobacteriuma) rhizogenes *[20] | Alternaria solani*[10] | BePMV*[7] (bell pepper mottle virus) |
| Agrobacteriuma) tumefaciens*[1] | Alternaria sp.*[1] | CarMoV*[4] (carnation mottle carmovirus) |
| Clavibacter michiganensis ssp. michiganensis*[1/*17] | Aspergillus sp.*[6] | CGMMV*[18] (cucumber green mottle mosaic virus) |
| Clavibacter michiganensis ssp. sepedonicus*[1] | Botrytis cinerea*[1/*17] | CMV*[4] (cucumber mosaic virus) |
| Curtobacterium flaccumfaciens*[21] | Candida albicans*[13] | CSVd*[7] (chrysanthemum stunt viroid) |
| Dickeya solani*[19] | | |
| Enterococcus faecium*[13] | Cercospora beticola*[10] | CyMV*[5/22] (cymbidium mosaic virus) |
| Erwinia amylovora*[3/*14] | Chalara elegans*[8] | |
| Erwiniab) carotovora ssp. atroseptica*[1] | Cladosporium fulvum*[21] | MNSV*[7] (melon necrotic spot virus) |
| Erwiniab) carotovora ssp. carotovora*[1/*10] | Colletotrichum coccodes*[10] | ORSV*[5/22] (odontoglossum ringspot virus) |
| Escherichia coli*[13] | Colletotrichum sp.*[1] | PepMV*[7/*17/22] (pepino mosaic v.) |
| Pectobacterium carotovorum ssp. atroseptica*[1] | Cylindrocladium scoparium*[1] | PFBV*[2/22] (pelargonium flower break virus) |
| Pectobacterium carotovorum ssp. carotovorum*[1/*10] | Cylindrocladium spathiphylli*[1] | PLCV*[2/22] (pelargonium leaf curl tombusvirus) |
| Proteus mirabilis*[13] | Dactylium dendroides*[1] | PLPV*[2/22] (pelargonium line pattern virus) |
| Pseudomonas aeruginosa*[13] | | |
| Pseudomonas fluorescens marginaeis*[16] | Didymella bryoniae*[17] | PMMoV*[7] (pepper mild mottle virus) |
| Pseudomonas lachrymans | Erysiphe cichoracearum*[17] | PSTVd*[7] (potato spindle tuber viroid) |
| Pseudomonas putida | Fusarium spp.*[17] | PVX*[4] (potato virus X) |
| Pseudomonas solanacearum* [1] | Fusarium oxysporum f.sp. cyclaminis*[1/*12] | PVY*[4] (potato virus Y) |
| | | RMV*[4] (ribgrass mosaic tobamovir.) |
| Pseudomonas syringae | Fusarium oxysporum (Stamm Elatiorbegonien)*[1] | TBRV*[2] (tomato blackring nepovirus) |
| Ralstonia solanacearum*[1] | Fusarium solani var. coeruleum*[1] | TMV*[2/22] (tabacco mosaic virus) |
| Rhizobium rhizogenes*[20] | | ToBRV *[22] (tomato blackring nepovirus) |
| Staphylococcus aureus* [13] | Helminthosporium solani *[1/*10/*11] | ToBRFV*[23] (tomato brown rugose fruit virus) |
| Xanth. camp. pv. begoniae* [1] | | |
| Xanthomonas campestris pv. campestris* [1] | Mucor sp.* [6] | ToMV*[17] (tomato mosaic virus) |
| | Ophiostoma quercus*[1] | TSWV*[2/22] (tomato spotted wilt tospov.) |
| Xanthomonas campestris pv. pelargonii*[1] | Peronospora tabacina*[8] | ZyMV*[7] (zucchini yellow mosaic virus) |
| | Phytium aphanidermatum*[17] | |
| | Pythium sp.*[6] | |
| | Phytium ultimum*[10] | |
| | Phytophthora cinnamomi*[1] | |
| | Phytophthora cryptogea*[1] | |
| | Phytophthora infestans*[10/*11] | |
| | Ramularia beticola*[10] | |
| | Rhizoctonia solani*[10] | |
| | Rhizopus sp.*[6] | |
| | Streptomyces scabies*[1] | |
| | Taphrina deformans*[15] | |
| | Thielaviopsis basicola*[1] | |
| | Trichoderma harzianum*9 | |
| | Trichoderma viride*[1] | |
| | Verticillium fungicola*[1/*9] | |



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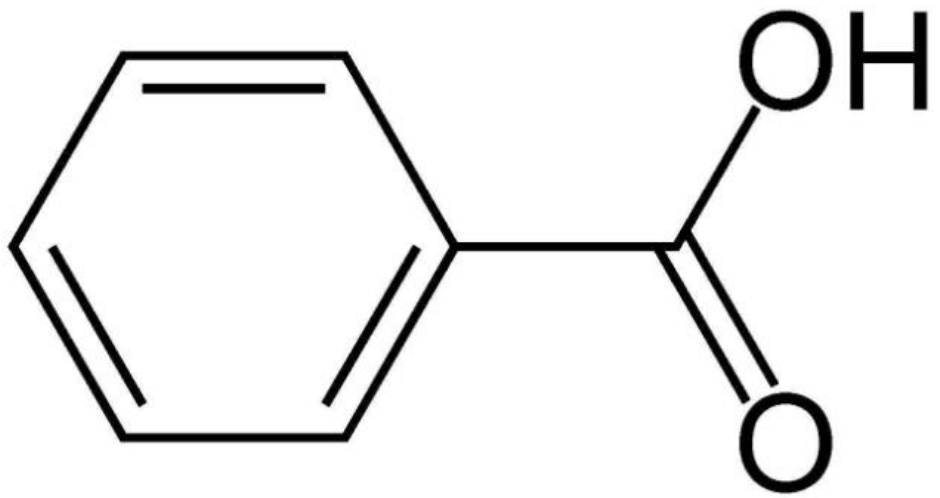
## Benzoic acid



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# Menno

## Hygiene in all crops

- Active ingredient Benzoic acid in Europe already authorized for the last 10+ years and for the coming years
- Made for horticulture (specific studies + >15y knowledge)
- tested for PLANT pathogens
- Stable solution
- Long-lasting and measurable effectiveness
- Foam application (longer exposure time, good covering cracks, visual control, vertical surfaces)
- Safe for materials (not aggressive, no corrosion)
- Safe for user (relatively low risks, see SDS)

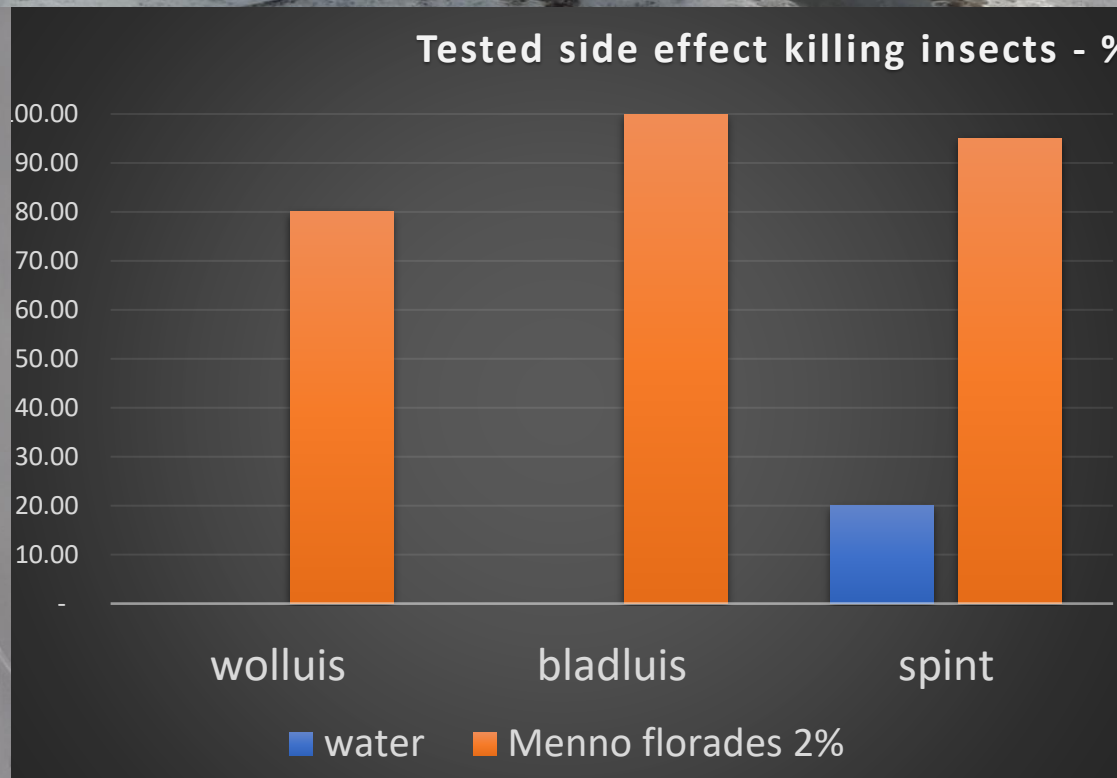
- Storage: long shelf life, without loss of quality
- Controllability by pH (re-use solution from dipping baths)
- Conventional and organic cultivation
- Fibl listing (ecologic certification)
- No residues
- Extensive spectrum of action
- GAP indication (against liverwort in Germany)
- Environmentally friendly


# Application Menno Clean

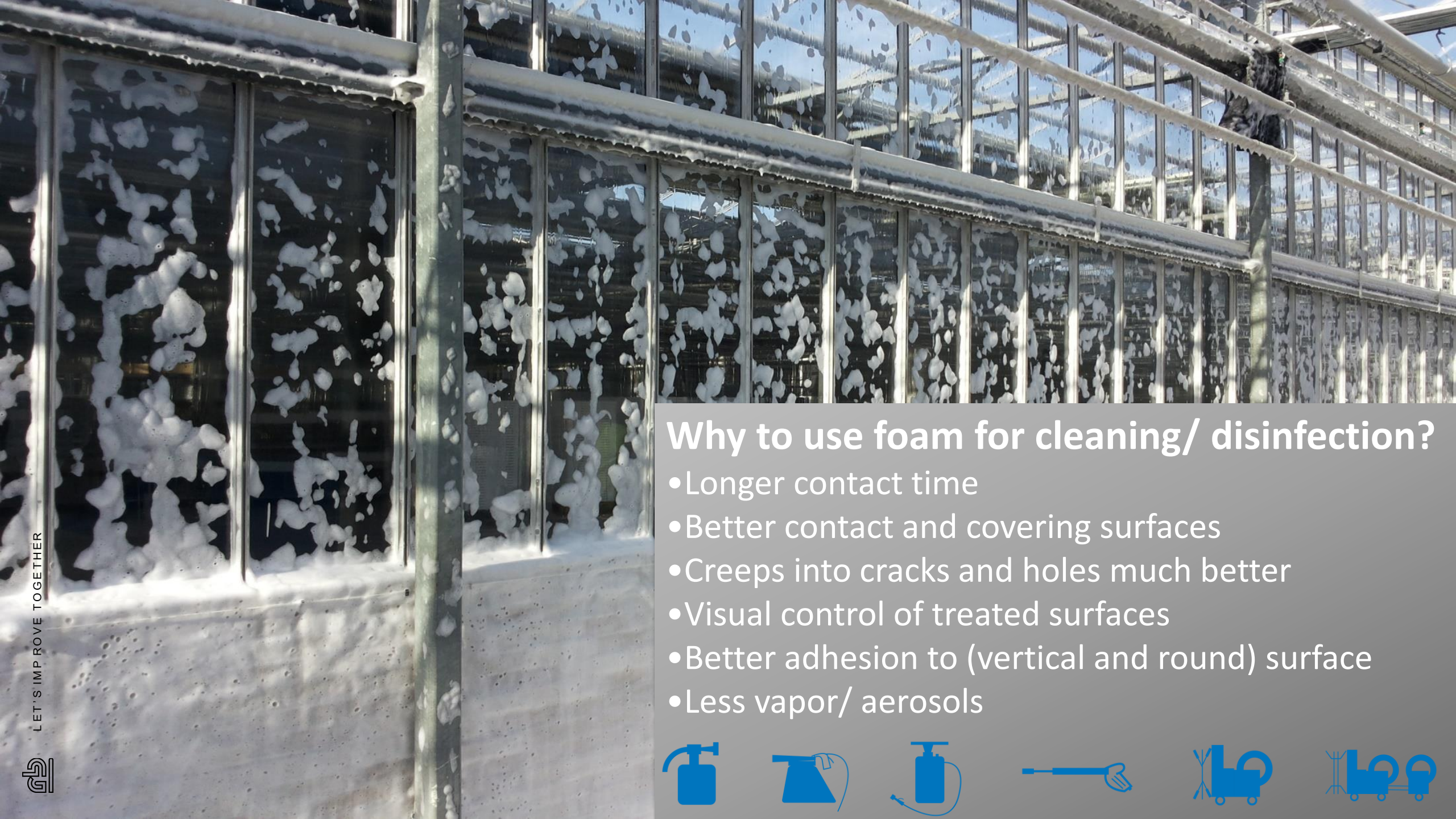
1. Greenhouse area:
   - Make sure everything is cleaned!
   - In case of virus → first treat the spots where infected plant has grown before start cleaning
   - Close air windows and doors minimum 2 hours before application
   - Temperature → minimum 15 degrees
2. Personal protection:
   - Wear skin-covering clothes
   - Wear gloves
   - Wear face shield/ goggles
3. Water quality for mixing disinfectant:
   - Make sure the mixing tank if free of residues and pollution!
   - Mix with rainwater or osmosis water
   - EC → as low as possible (close to 0)
   - pH → 6 – 8
   - Temperature → minimum 15 degrees
4. Quantities per ha.
   - Minimum 0,2l total solution per m2 (applies in every situation)
   - For greenhouse with cultivation gutters → approx. 3500l p/ha.
5. After application
   - Keep air window closed for minimum 8 hours
   - After that, heating up and venting well
   - Dried up = safe for tomato crop
   - No need to rinse surfaces after application
   - In case of standing water → measure pH >4,5 it is not active anymore

# Hygiene step with side effect (IPM)

| Versuchs-ansatz | Behandlung | Anzahl über-lebender Thripse Mittel aus vier Wdh. (n = 15) | Wirkungsgrad (% der Kontrolle) |
|---|---|---|---|
| 1 | Leitungswasser | 11,5 | - |
| | MENNO-Florades (3 %) | 0 | 100 |
| | M&ENNO TER forte (1 %) | 0 | 100 |
| 2 | Leitungswasser | 11,5 | - |
| | MENNO-Florades (1 %) | 0 | 100 |
| 3 | Leitungswasser | 10,0 | - |
| | MENNO-Florades (0,5 %) | 2,3 | 77 |




Research Thrips puppae (Geisenheim 11/2000, Gartnerborse 09/2001)
Experience thrips in strawberry, tomato, pepper
Experience mealybug in Phalenopsis, tomato
Difference with dirty or clean groundcover



## Why to use foam for cleaning/ disinfection?

- Longer contact time
- Better contact and covering surfaces
- Creeps into cracks and holes much better
- Visual control of treated surfaces
- Better adhesion to (vertical and round) surface
- Less vapor/ aerosols



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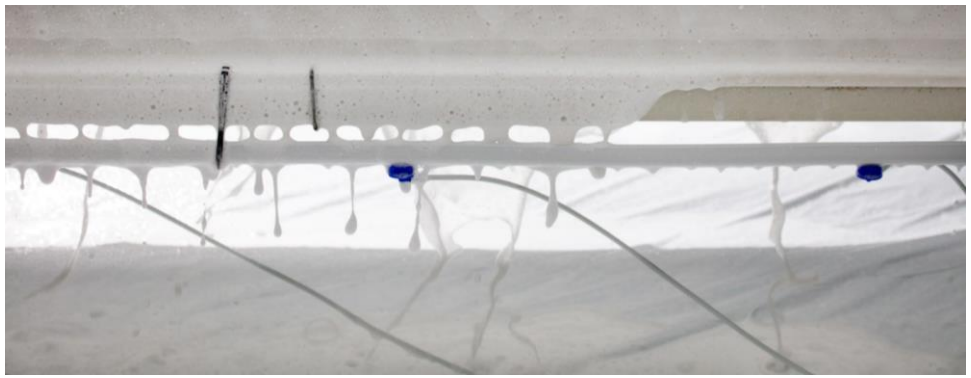
# Foam treatments during crop rotation

*HortiseptCleanPLUS or Fadex H+ & Menno*






Menno
florades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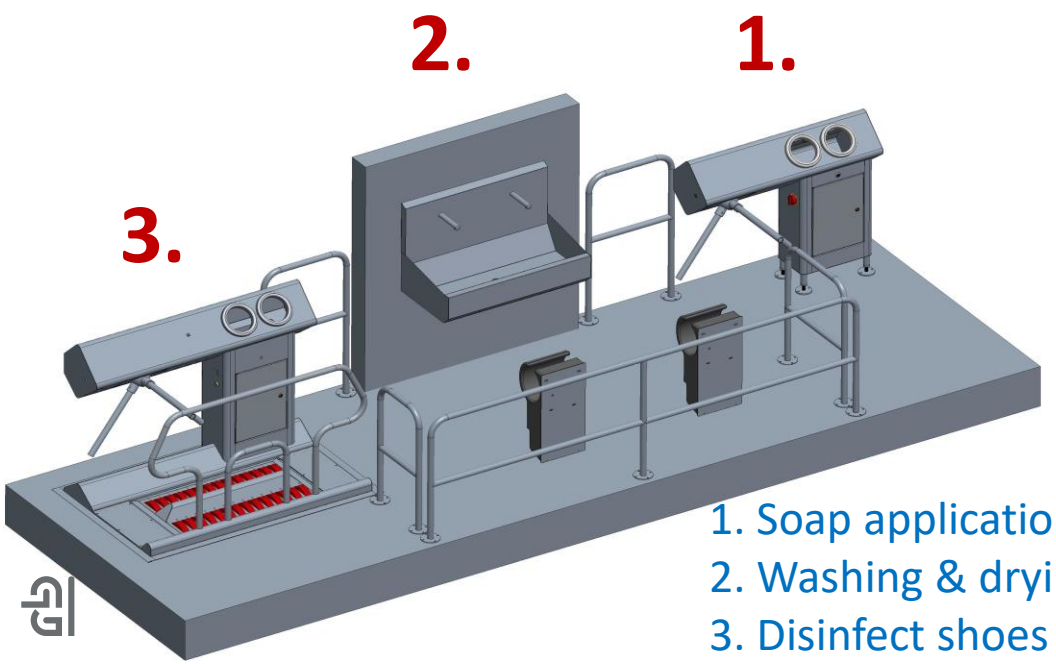
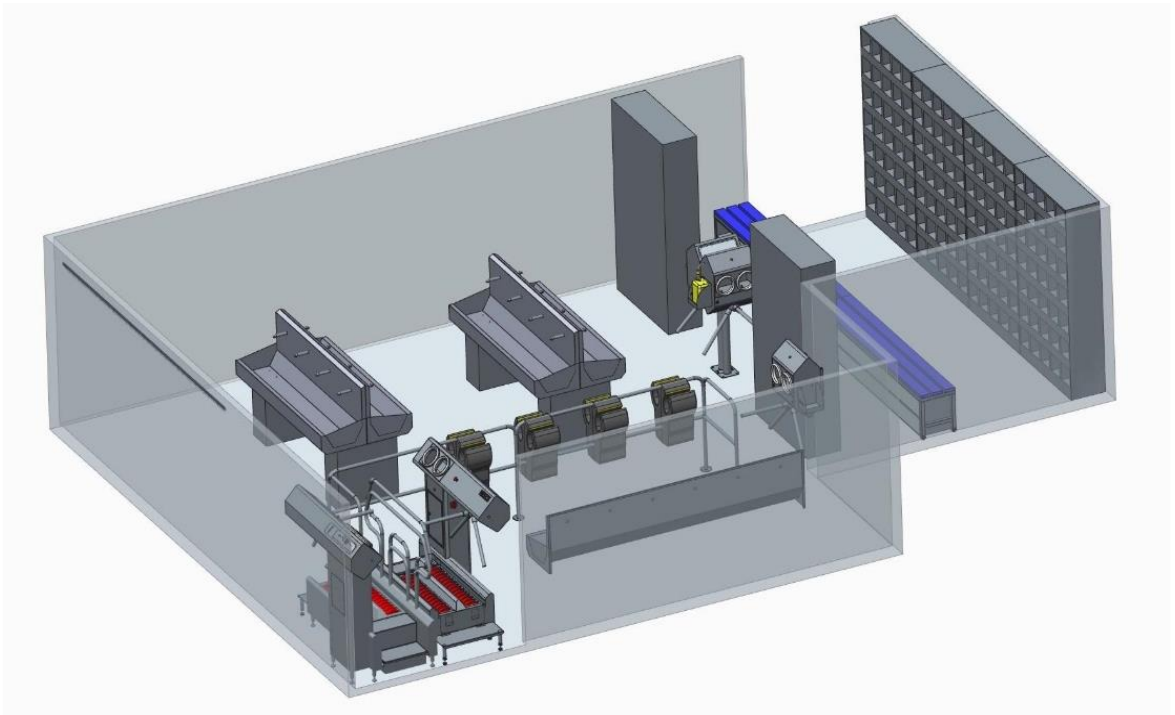
**(re)-building plans? Call us to take a look to the hygiene steps**

# Optimal hygiene set up


1. Soap application
2. Washing & drying hands
3. Disinfect shoes & hands

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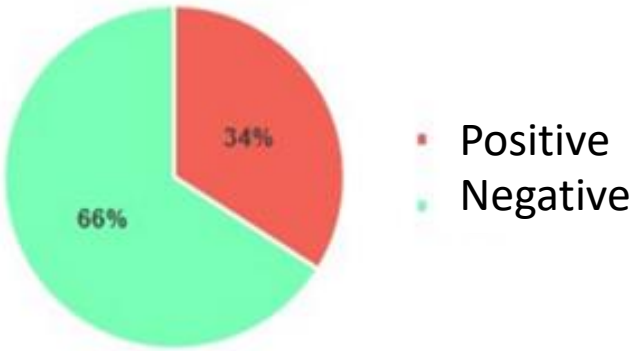
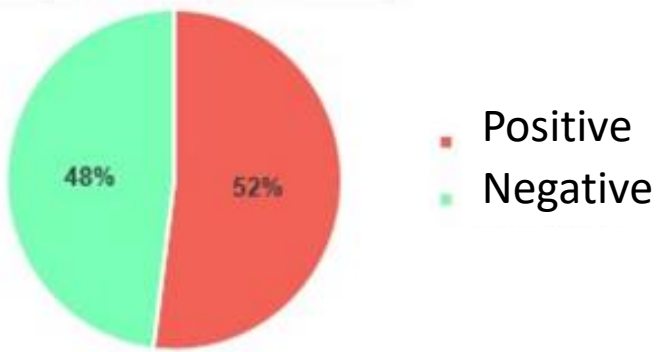
# Risks of viruses on cellphones (without zipbag)

ToBRFV




ToBRFV/PepMV/CGMMV





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# UV- cabinet to treat visitor's small items


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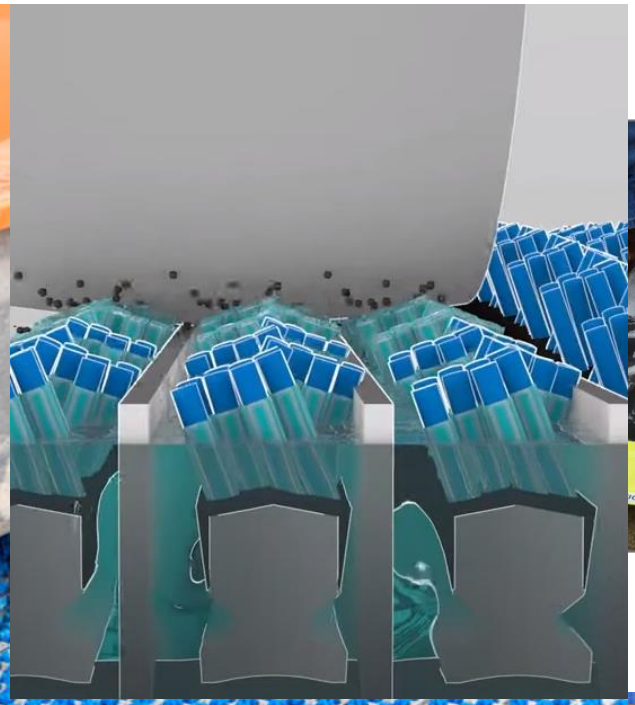
# Developments in prevention the spread of germs caused by transport and persons.



Stabiele werkzaamheid
Meetbaar (pH)
Behoud van materiaal

Royal Brinkman video's Youtube – [Flexxomat met Menno Florades]

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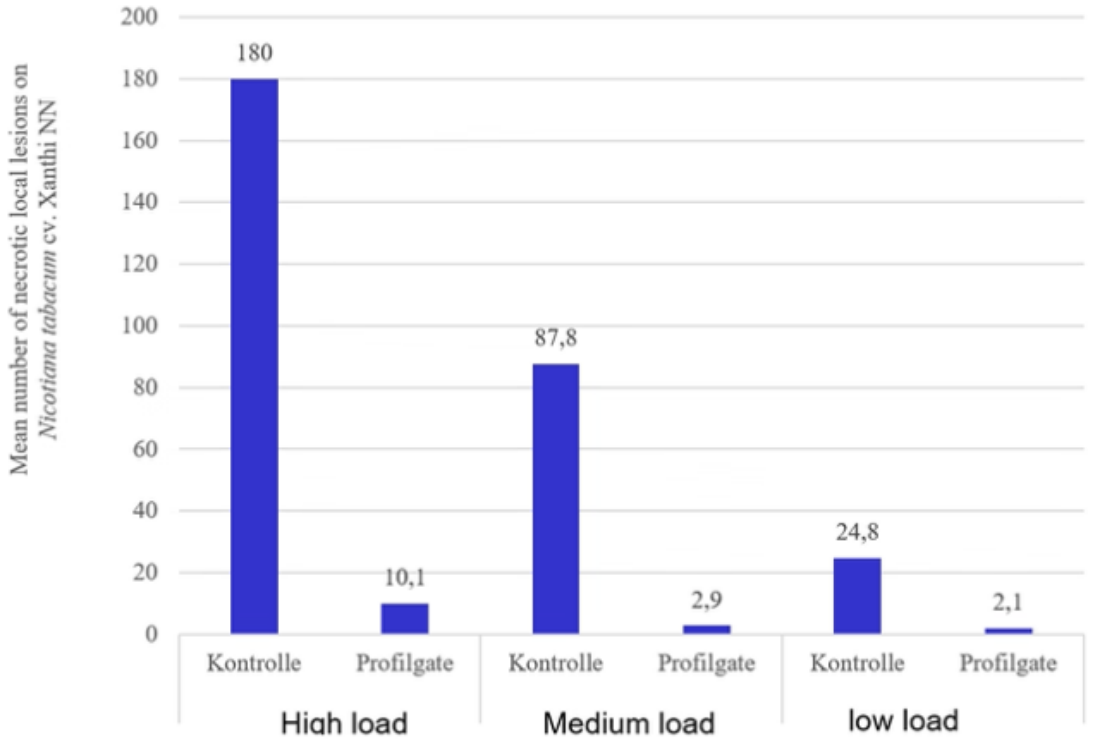
# Researching the effect of a brush system with Menno - ToBRFV

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# Research disinfection of (pre) wash contaminated clothes

## CLEANING OF ToBRFV-CONTAMINATED FABRICS

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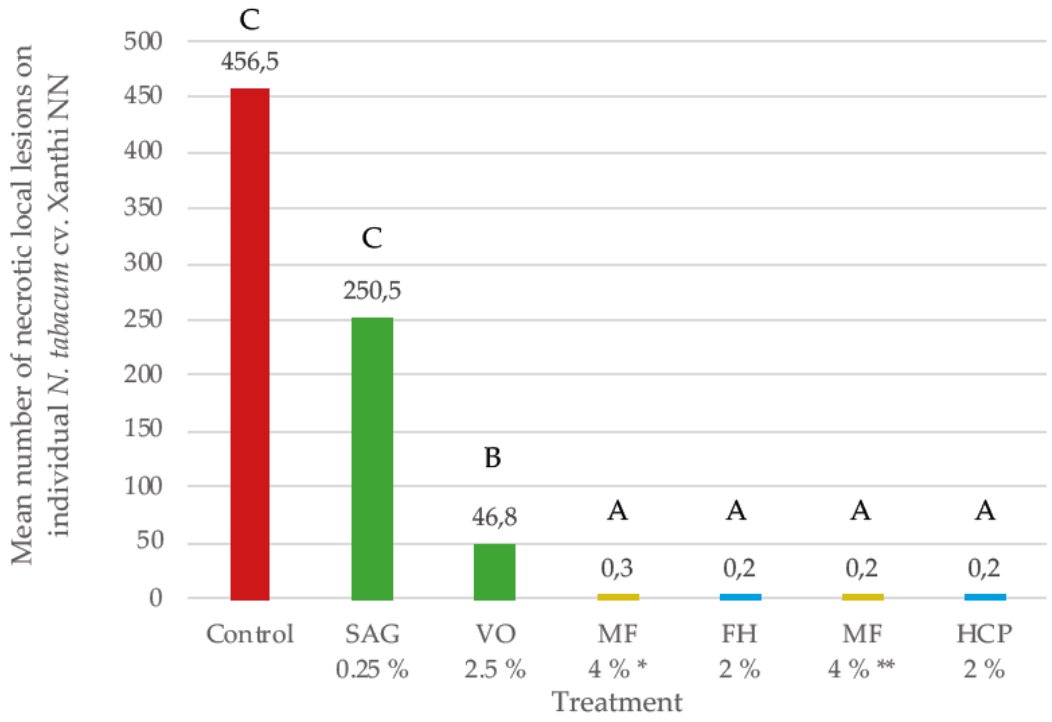


- Mechanical rub-inoculation resulted in reliable expression of necrotic local lesions **(control)**
- **Household products** did not result in sufficient removal of the ToBRFV contaminated plant sap from clothing
- **Agricultural detergents** and the **disinfectant** achieved nearly complete removal of ToBRFV from contaminated clothing

- In a highly infected greenhouse, after 30 minutes a disposable jumpsuit became high enough contaminated to transmit ToBRFV to uninfected test plants!

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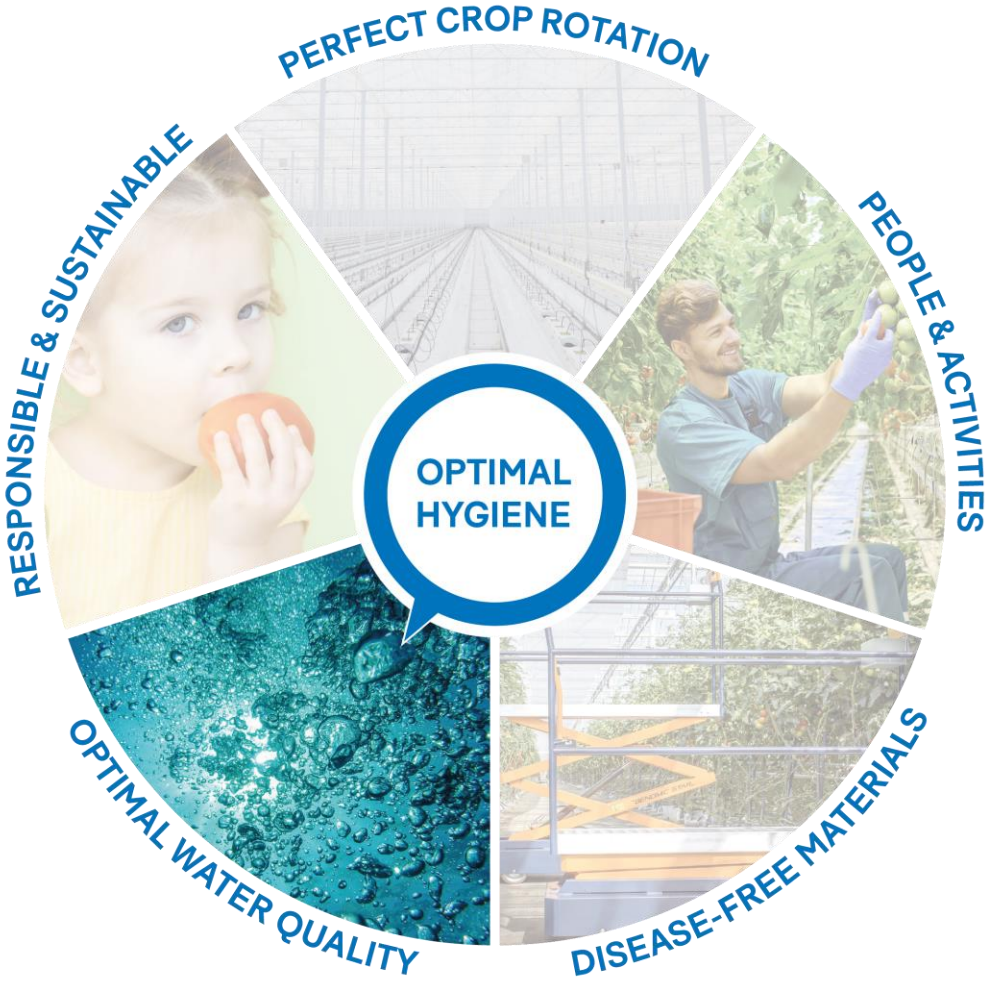
# Water quality from basin till plant

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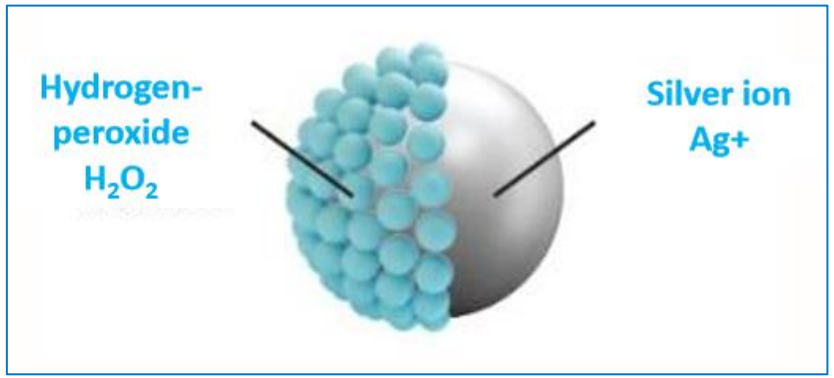
# Optimal water quality for your crop

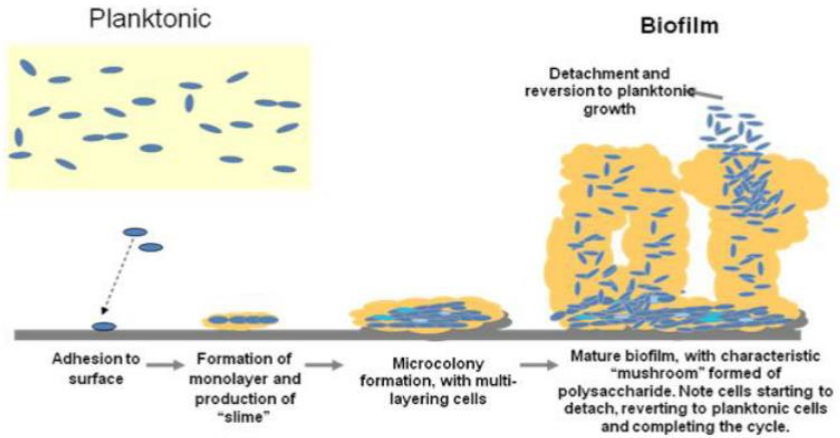
Bacteria, fungi and viruses often spread quickly through the crop by (irrigation) water.
To prevent this, a clean water system is of important.

A combination of technique, agent and support is of great value for achieving optimal water quality.

- ❑ **Moleaer** nanobubble technology for aerating starting water or irrigation water.
- ❑ **Huwa-San TR50** stabilized peroxide for cleaning, cleaning and disinfecting the entire piping system, including during cultivation for optimal effect.

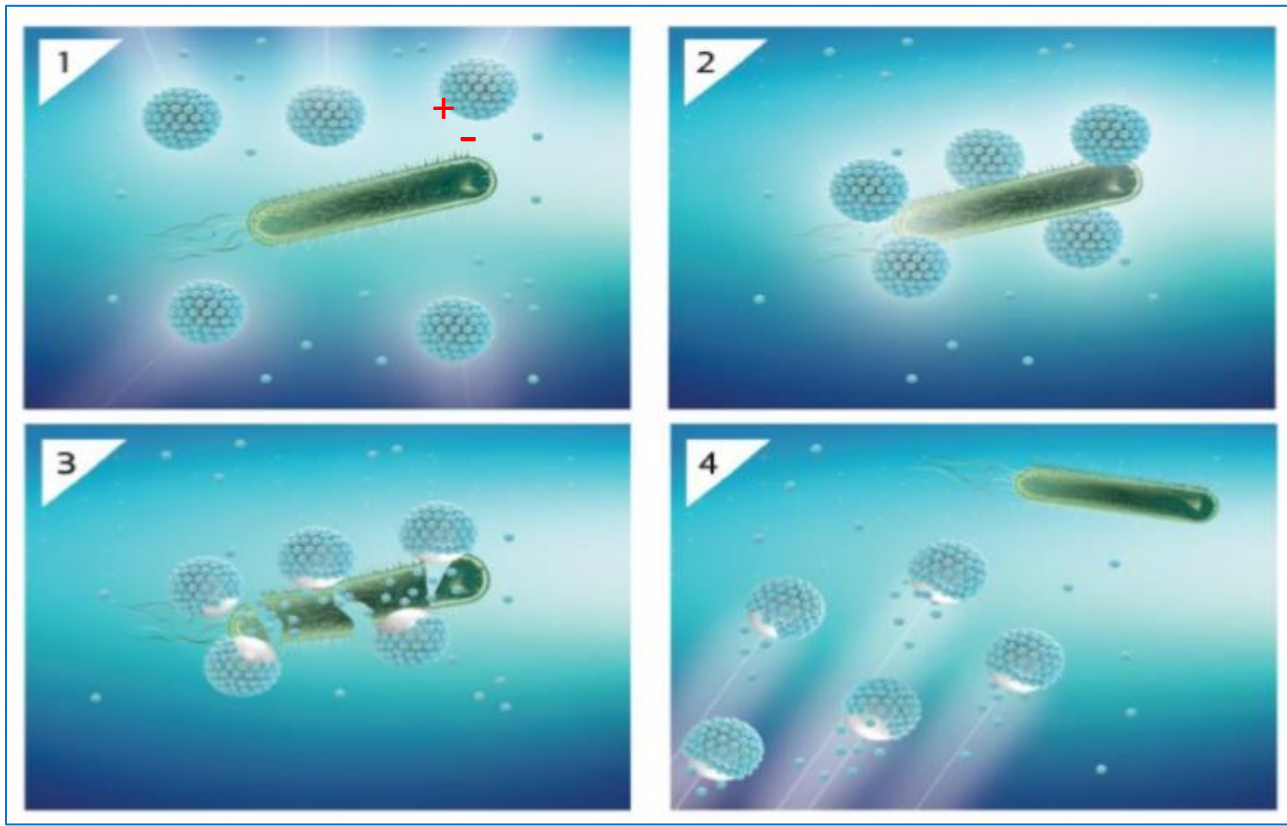
# Huwasan-TR50 mode of action



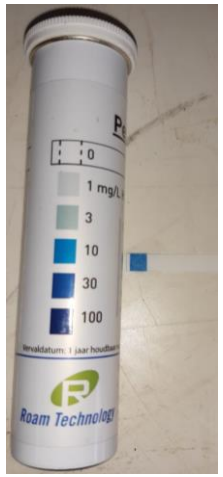



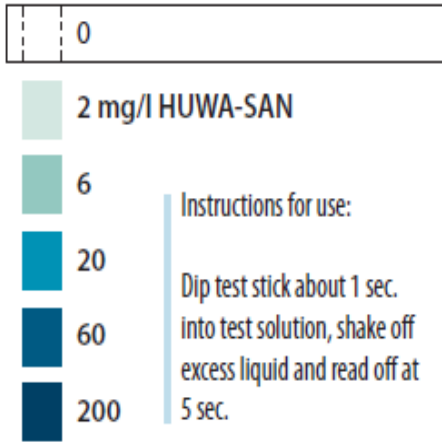

Hydrogen peroxide (H2O2) stabilized with silver ion

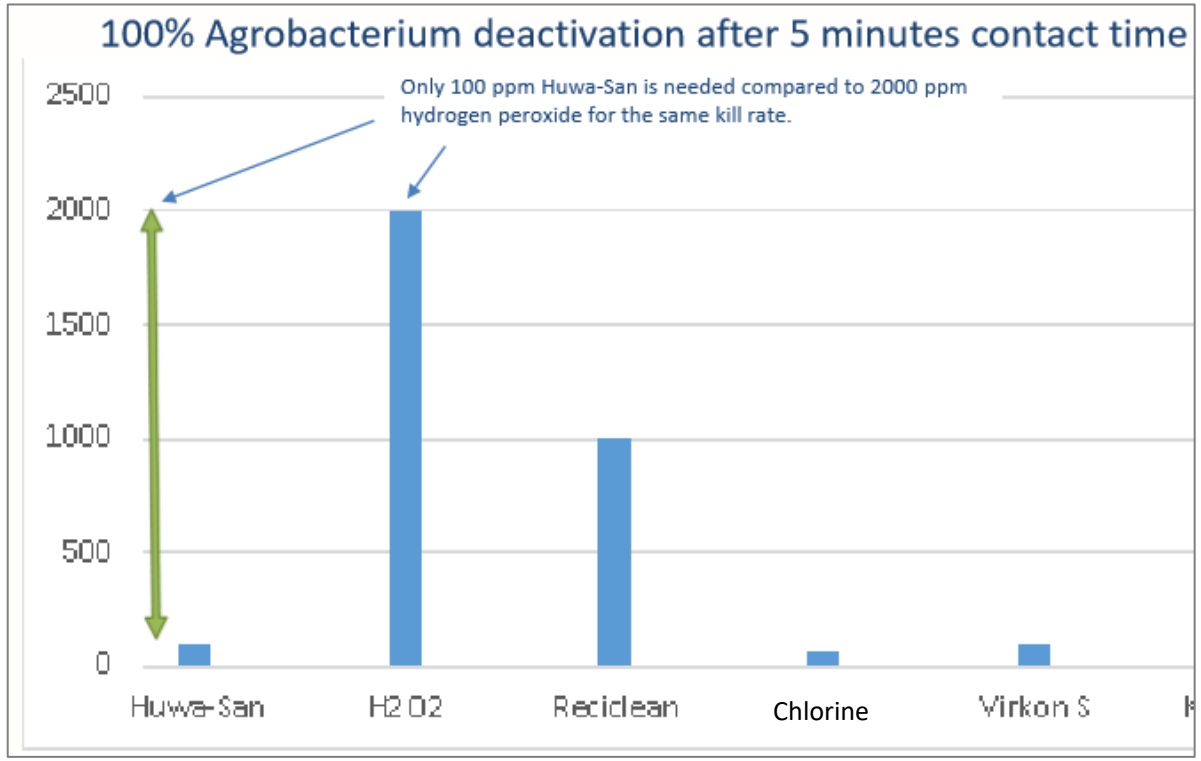
1. Silver attract effective towards the bacteria (charge)
2. Silver ion paralyses the bacteria (easier oxidation)
3. Hydrogen peroxide (radicals) reacts with the bacteria
4. Remaining peroxide binds itself back to the silver ion to repeat the process



# Huwa-San USP's


- Very stable
- More effective than standard (35%) hydrogen peroxide
- No harmful residues- or by-products
- Broad spectrum of activity
- Easily measurable with an indicator strip
- Safe for humans, crops and environment
- Specialists worldwide share advice & experience to help customers and secure effective usage of the product
- 1% Huwa-San with a contact time of 14hr = effective against ToBRFV

# Purpose

- Irrigation systems: Drip lines, sub irrigation (concrete floor, tables), sprinkler irrigation

- Remove and prevent biofilm
  - → Keep pipes and system clean
  - → Improve supply of fertilizers

- Maximize the water quality
  - → Keep water disease free
  - → Increase oxygen levels in the water

- Disinfection of surfaces (spray and fog treatment) and slabs that are reused

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# Combined application Moleaer/ Huwa-San TR-50

- At rainwater basin
- goal: clean basin = better starting water
- effect: efficient use of Huwa-San


- At day storage tank
- goal: oxygen enrichment
- effect: no root suffocation making plants less susceptible and better nutrient uptake

- At day storage tank or direct in-line at the unit
- goal: keeping infections under control in water and water supply
- effect: no diseased plants, no biofilm and equal watering

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# Thank you for your attention!

Do not hesitate to contact me!

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**Email:** jasper.verhoeven@royalbrinkman.com

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# Royal Brinkman Technologies




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global specialist in horticulture