



# General conditions – Registration



## At first disinfection, then production!

- Fight against plant pathogens for example:  
Bacteria,  
Fungi (and their duration forms),  
Viruses and Viroids
- Demand of Registration as  
Plant Protection Product

**Products without a registration according 91/414/EC are not permitted for Surface-disinfection in Warehouses, for machines or boxes!**



## Potato Warehouse Hygiene - how to evaluate!



**1. Registration as Plant Protection Product!**

⇒ **MENNO Florades®**

**2. Broad Spectrum of Effectiveness**

**bactericidal, fungicidal and virucidal**

**3. Applicable in many areas**

**Floriculture**

**Horticulture** (Horticulture/Mushrooms)

**Agriculture** (Potato)

**4. Exceptional good Plant tolerance**

**5. Proper Human- and Ecotoxicologie**

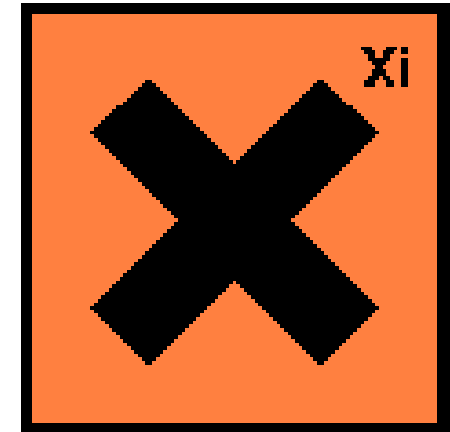




# Toxicology and Ecotoxicology



- **Active ingredient in the concentrate: 9 % Benzoic acid**  
⇒ 1 % ige ready solution: 0,09 % Benzoic acid
- **Acut toxicity of product concentrate:**
  - ◆ acute oral toxicity ⇒ „non-toxic“  
Rat (24 hours or 14 days): LD<sub>50</sub> > 2000 mg/kg
  - ◆ acute dermal toxicity ⇒ „non-toxic“  
Rat (24 hours or 14 days): LD<sub>50</sub> > 2000 mg/kg
  - ◆ acute dermale irritation ⇒ „non-irritating“  
Rabbit - skin (exposition 4 hours)
  - ◆ acute Eye irritation ⇒ „corrosive“ (R 41 Risk of serious damage to eyes)  
Rabbit - (0,1 g directly into the conjunctival sac, 24hours exposition)
- **Good biological degradability**
- **Water dangerous classification WGK1**



**Xi-Irritant**

**Benzoic acid is for instance allowed as preservative in food stuffs with 9 g/kg, as e.g. in Sausage and Mayonnaise.**



# Tested spectrum of effectiveness - Fungi



Agaricus bisporus* <sup>9</sup>	Cylindrocladium scoparium* <sup>1</sup>	Phytophthora cinnamomi* <sup>1</sup>
Alternaria alternata* <sup>10</sup>	Cylindrocladium spathiphylli* <sup>1</sup>	Phytophthora cryptogea* <sup>1</sup>
Alternaria solani* <sup>10</sup>	Dactylium dendroides* <sup>1</sup>	Phytophthora infestans* <sup>10</sup> / <sup>*11</sup>
Alternaria sp.* <sup>1</sup>	Fusarium oxysporum f.sp. cyclaminis* <sup>1</sup> / <sup>*12</sup>	Ramularia beticola* <sup>10</sup>
Aspergillus sp.* <sup>6</sup>	Fusarium oxysporum (Stamm Elatiorbegonien) * <sup>1</sup>	Rhizoctonia solani* <sup>10</sup>
Botrytis cinerea* <sup>1</sup>	Fusarium solani var. coeruleum* <sup>1</sup>	Rhizopus sp.* <sup>6</sup>
Candida albicans* <sup>13</sup>	Helminthosporium solani * <sup>1</sup> / <sup>*10</sup> / <sup>*11</sup>	Thielaviopsis basicola* <sup>1</sup>
Cercospora beticola* <sup>10</sup>	Mucor sp.* <sup>6</sup>	Trichoderma harzianum* <sup>9</sup>
Chalara elegans* <sup>8</sup>	Peronospora tabacina* <sup>8</sup>	Trichoderma viride* <sup>1</sup>
Colletotrichum coccodes* <sup>10</sup>	Pythium sp.* <sup>6</sup>	Verticillium fungicola* <sup>1</sup> / <sup>*9</sup>
Colletotrichum sp.* <sup>1</sup>	Phytium ultimum* <sup>10</sup>	

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**Effectiveness tests against Fungi are prepared with vegetative forms and also against spores and duration forms**



# Tested spectrum of effectiveness - Bacterias and Viruses



Viruses / Viroids		Bacterias	
ArMV* <sup>2</sup> (arabis mosaic nepovirus)	PLPV* <sup>2</sup> (pelargonium line pattern virus)	Acidovorax avenae ssp. cattleyae* <sup>1</sup>	Pseudomonas lachrymans
BePMV* <sup>7</sup> (bell pepper mottle virus)	PMMoV* <sup>7</sup> (pepper mild mottle virus)	Agrobacterium tumefaciens* <sup>1</sup>	Pseudomonas putida
CarMoV* <sup>4</sup> (carnation mottle carmovirus)	PSTVd* <sup>7</sup> (potato spindle tuber viroid)	Clavibacter michiganensis ssp. michiganensis* <sup>1</sup>	Pseudomonas solanacearum* <sup>1</sup>
CMV* <sup>4</sup> (cucumber mosaic virus)	PVX* <sup>4</sup> (potato virus X)	Clavibacter michiganensis ssp. sepedonicus* <sup>1</sup>	Pseudomonas syringae
CSVd* <sup>7</sup> (chrysanthemum stunt viroid)	PVY* <sup>4</sup> (potato virus Y)	Enterococcus faecium* <sup>13</sup>	Ralstonia solanacearum* <sup>1</sup>
CyMV* <sup>5</sup> (cymbidium mosaic virus)	RMV* <sup>4</sup> (ribgrass mosaic tobamovirus)	Erwinia amylovora* <sup>3/*14</sup>	Staphylococcus aureus* <sup>13</sup>
MNSV* <sup>7</sup> (melon necrotic spot virus)	TBRV* <sup>2</sup> (tomato blackring nepovirus)	Erwinia carotovora ssp. atroseptica* <sup>1</sup>	Xanthomonas campestris pv. begoniae* <sup>1</sup>
ORSV* <sup>5</sup> (odontoglossum ringspot virus)	TMV* <sup>2</sup> (tobacco mosaic virus)	Erwinia carotovora ssp. carotovora* <sup>1/*10</sup>	Xanthomonas campestris pv. campestris* <sup>1</sup>
PepMV* <sup>7</sup> (pepino mosaic virus)	ToMV (tomato mosaic virus)	Escherichia coli* <sup>13</sup>	Xanthomonas campestris pv. pelargonii* <sup>1</sup>
PFBV* <sup>2</sup> (pelargonium flower break virus)	TSWV* <sup>2</sup> (tomato spotted wilt tospovirus)	Proteus mirabilis* <sup>13</sup>	
PLCV* <sup>2</sup> (pelargonium leaf curl tobusvirus)	ZyMV* <sup>7</sup> (zucchini yellow mosaic virus)	Pseudomonas aeruginosa* <sup>13</sup>	



# Examination of effectiveness for MENNO Florades® with application against economical relevant diseases at potatoes and sugar-beets



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## Introduction

The product MENNO Florades® with the active ingredient Benzoic acid was at first for floriculture registered as Special-Disinfectant. In the Potato Production it is allowed among others for control of the quarantine diseases *Clavibacter michiganensis ssp. sepedonicus* and *Ralstonia solanacearum* for disinfection of warehouses, boxes as well as equipment and machines. Because of the fungicid and bactericid effectiveness and additionally the exceptional good plant tolerance of MENNO Florades® *in vitro*-tests, trials of disinfection and treatments of plants- and crops as well as leaf applications on potato and sugar-beet was carried out.

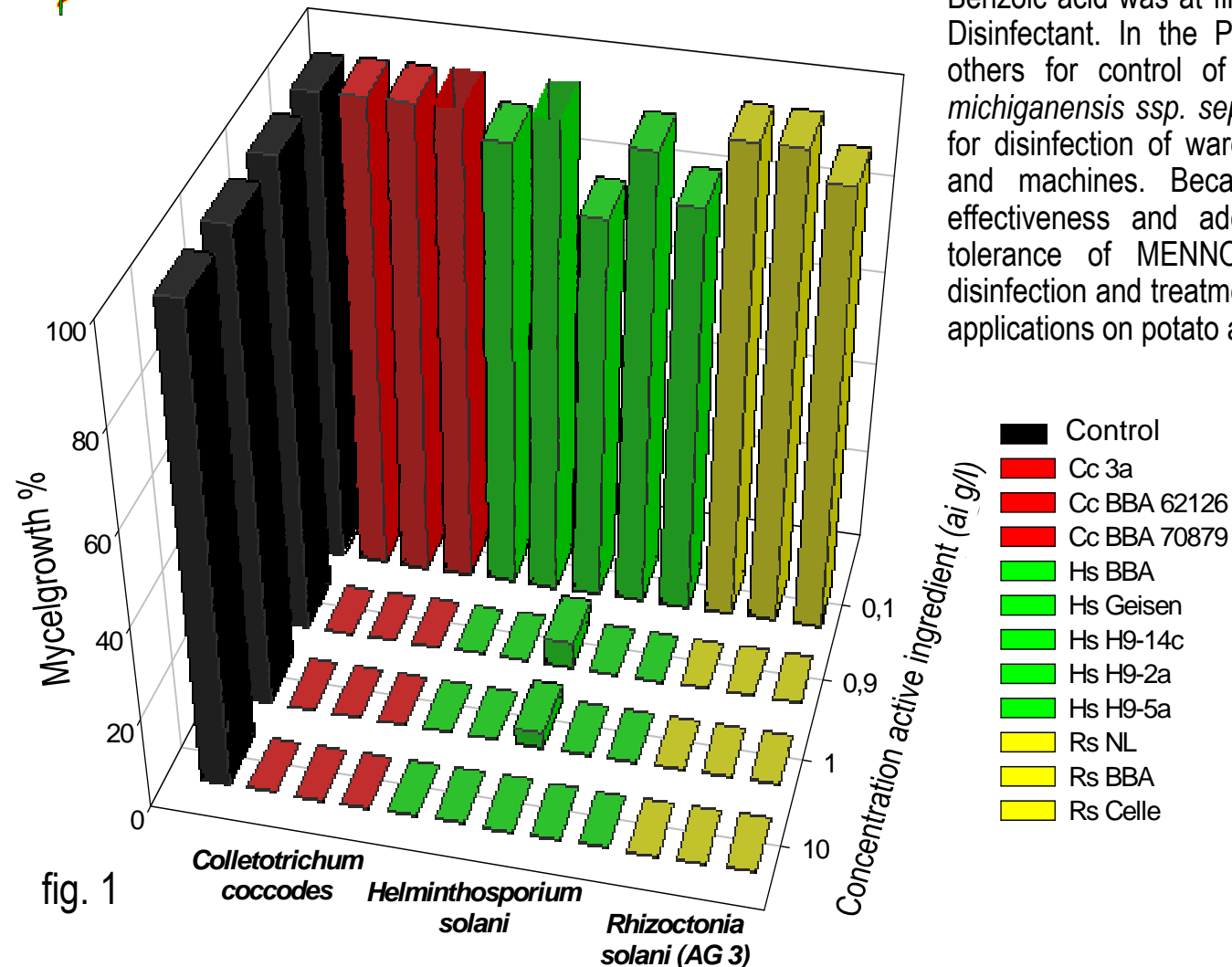


fig. 1

## In vitro

*In vitro*-tests evaluating effectiveness of Benzoic acid on the Mycel- resp. Germ growth was carried out with several potato- and sugar-beet-germs. Starting with a concentration of 0,9 ai g/l active ingredient (= 1% product) Benzoic acid confirms a very good mycel- resp. growthinhibition effect (fig. 1 + 2).



# Examination of effectiveness for MENNO Florades® with application against economical relevant diseases at potatoes and sugar-beets

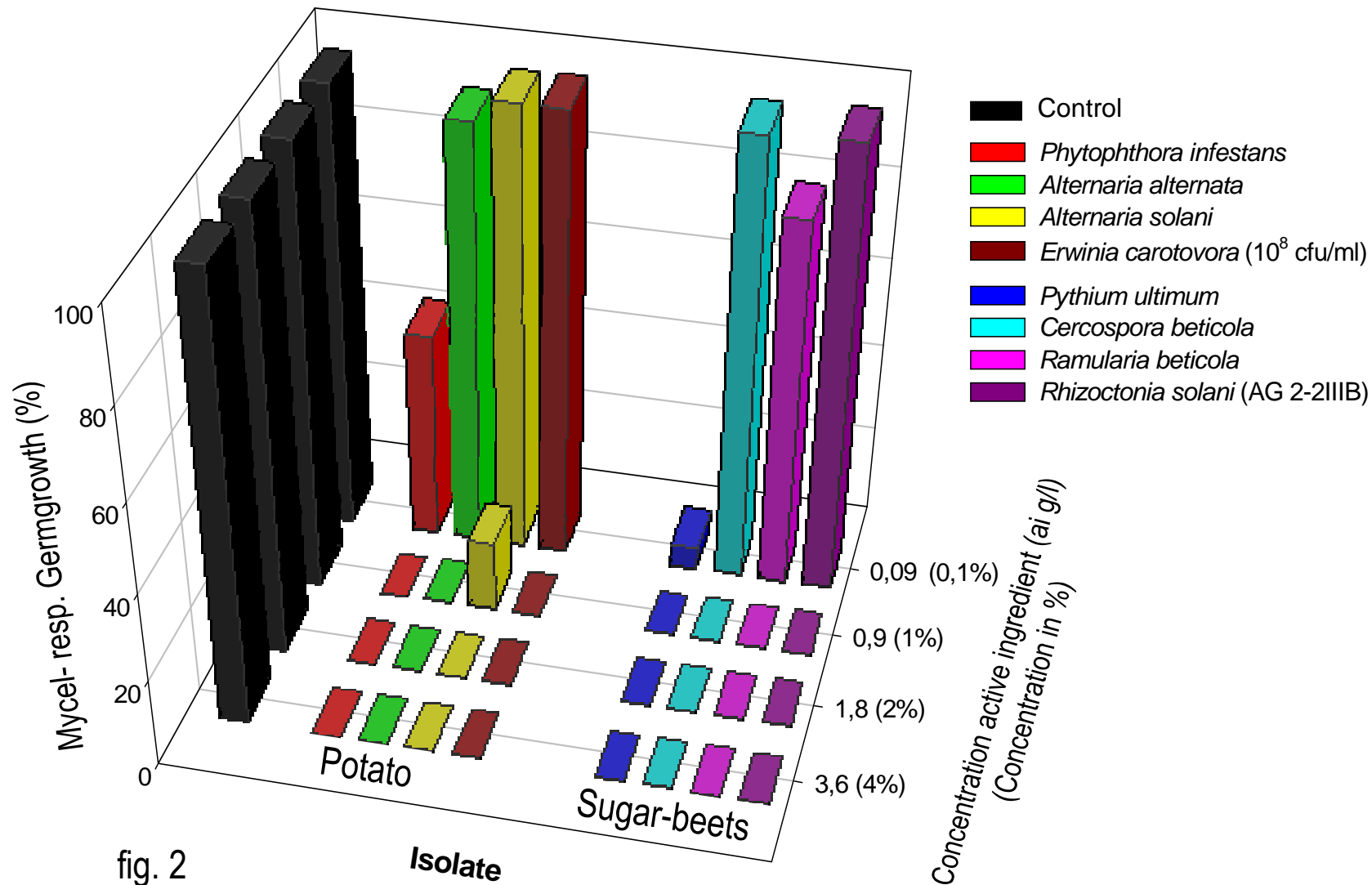


fig. 2



## Examination of effectiveness for MENNO Florades® with application against economical relevant diseases at potatoes and sugar-beets



### Phytotoxicity

Examining possibly Phytotoxicity Seed- as well as leafapplications on potatoes and sugar-beets in high concentrations was carried out. The Seedtreatment on potato tubers with MENNO Florades before planting makes no Phytotoxicity, but stimulates the growth of the potato plants (fig. 3).

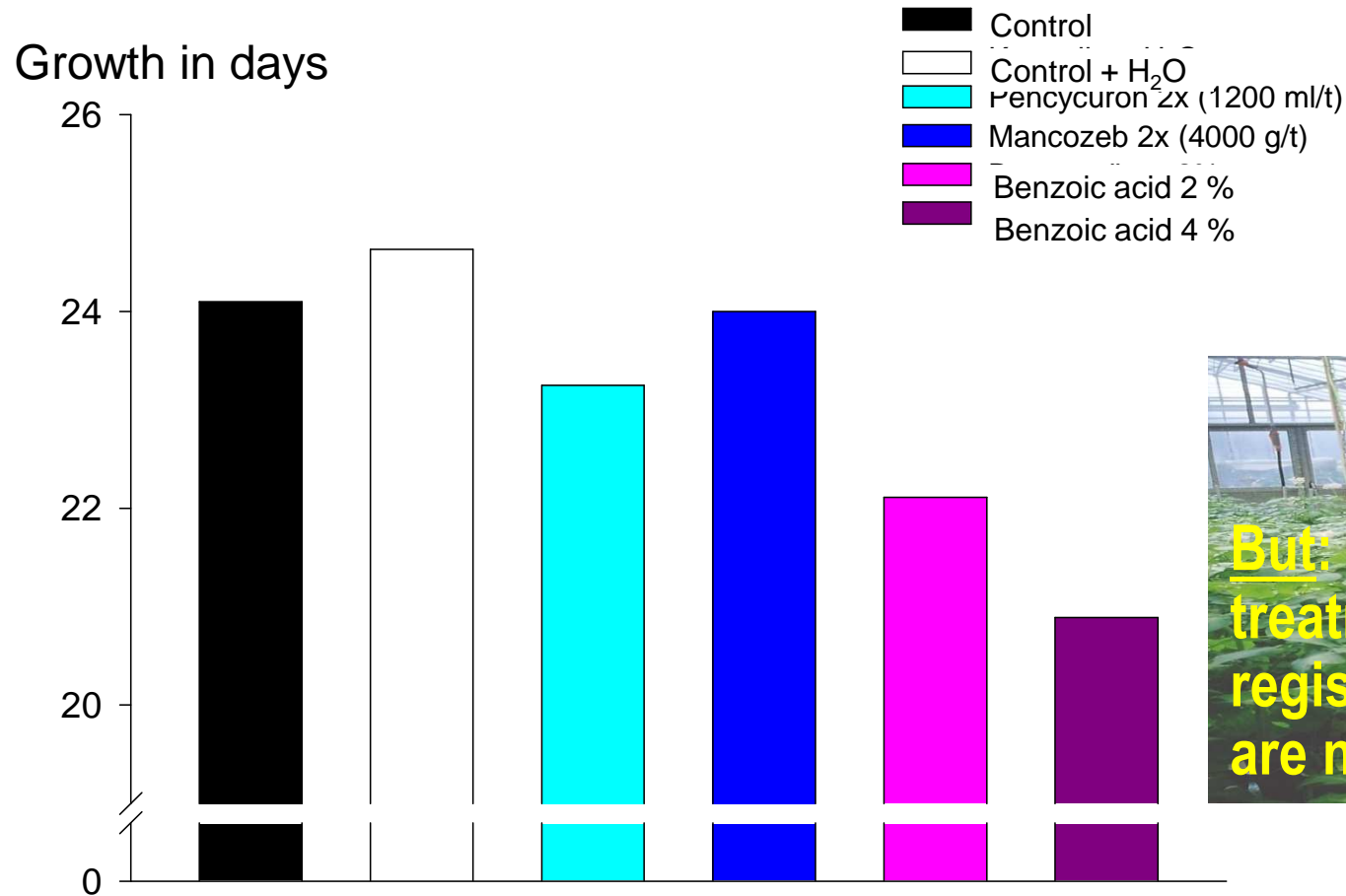


fig. 3

Treatment

Sort: Karlena  
(with sprout <5mm)



## Fungicid effectiveness of MENNO Florades® - exposure times



**Survival of test germs** (number germ carriers with growth of fungi after treatment)

conc. [%]	Phytophthora cinnamomi	Rhizoctonia	Thielaviopsis basicola	Fusarium solani var. coeruleum	Cylindrocladium scoparium
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**without peat load**

	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h
0,50	0	0	0	1	0	0	3	3	0	not tested			2	1	0
1,00	0	0	0	1	0	0	3	0	0	0	0	0	2	0	0
2,00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

**with peat load**

	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h
0,50	0	0	0	1	0	0	3	3	0	not tested			2	1	0
1,00	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
2,00	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

0

= complete effectiveness (n = 3)

**Recommendation: 2 % and 4 hours**

**At this concentration and exposure time all fungi (including the most resistant fungi) and their duration forms are killed, also with load of dirtyness.**

Results in vitro – laboratorial trials



## Fungicid effectiveness of MENNO Florades® - exposure times



**Survival of test germs** (number germ carriers with growth of fungi after treatment)

conc. [%]	Botrytis cinerea test 01	Helminthosporium solani	Alternaria sp.	Mucor sp.	Colletotrichum sp.
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**without peat load**

	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h
0,50	0	0	0	not tested			3	3	0	3	3	3	3	2	0
1,00	0	0	0	0	0	0	3	0	0	3	2	3	2	0	0
2,00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**with peat load**

	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h	1 h	4 h	16 h
0,50	3	0	0	not tested			3	3	0	3	3	3	3	3	0
1,00	0	0	0	0	0	0	3	0	0	3	3	3	3	0	0
2,00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0 = complete effectiveness (n = 3)

Results in vitro – laboratorial trials



## Bactericid effectiveness of MENNO Florades® - exposure times



**Survival of test germs** (number germ carriers with growth of bacteria after treatment)

conc. [%]	Ralstonia solanacearum			Pseudomonas solanacearum			Claviabacter mich. ssp. sepedonicus			Erwinia carotovora subsp. atroseptica			Erwinia carotovora subsp. carotovora		
	with germ carriers metal surface			without peat load											
	15 min	30 min	60 min	5 min	15 min	30 min	15 min	30 min	60 min	1 min	2 min	3 min	1 min	2 min	3 min
0,25	n.t.	n.t.	n.t.	0	0	0	0	0	0	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
0,50	n.t.	n.t.	n.t.	0	0	0	0	0	0	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
1,00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,00	0	0	0	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	0	0	0	0	0	0

**with peat load**

	15 min	30 min	60 min	5 min	15 min	30 min	15 min	30 min	60 min	1 min	2 min	3 min	1 min	2 min	3 min
0,25	n.t.	n.t.	n.t.	0	0	0	0	0	0	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
0,50	n.t.	n.t.	n.t.	0	0	0	0	0	0	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
1,00	n.t.	n.t.	n.t.	0	0	0	0	0	0	0	0	0	0	0	0
2,00	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	0	0	0	0	0	0

Ralstonia = Pseudomonas

n.t. = not tested



# Scale of mirco-organism



Organism	Germ	Disease	Size
Virus	<i>PVX (potatoe virus x)</i>	Mosaikscheckung	515 x 13 nm
Bacteria	<i>Clavibacter michiganensis ssp sepedonicus</i>	Bakterienringfäule	0,4 – 0,75 x
	<i>Ralstonia solanacearum</i>	Schleimkrankheit	0,8 – 2,5 µm
	<i>Erwinia ssp.</i>	Black leg. Bacterial Soft Rot	0,5 – 3 µm
Nematod	<i>Globodera pallida</i>	Wachstumsstockung	450 – 1200 µm
	<i>Ditylenchus dipsaci</i>	Wachstumshemmung	1 mm x 60 µm

**Diameter of human hair 100 µm**  
 (1 mm corresponding 1000 µm  
 1 µm corresponding 1000 nm)

**That's why: really all surfaces have to be treated!**  
**Each cm<sup>2</sup> left untreated – means a high risk  
 of new infection potential!**

**Interval of reproduction:** e.g. of bacterias - 20 min.

**Rate of reproduction:** in 10 hours = 30 x

Up to  $1 \times 10^6$  (1 million) bacterias per mm<sup>2</sup> can grow.

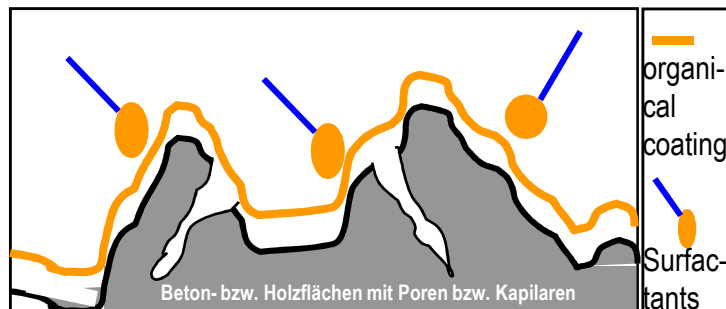




# Cleaning

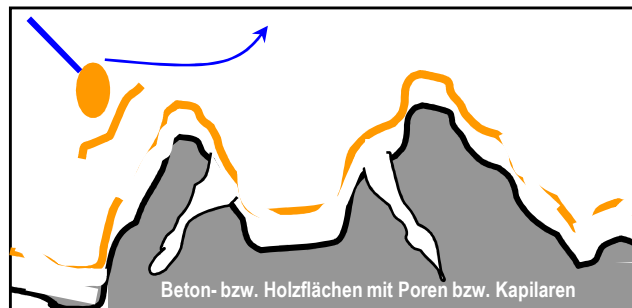


- **Pre-cleansing** – with hoover, shovel, broom, – mechanically cleansing of surfaces from potato rests, sand, dust, adheres of earth, etc.
- **Wet-cleansing with high-pressure machines** all surfaces of storing by using **pressure, big volumes of water and use of surfactants.**



Before starting any disinfection, all areas and equipment must be thoroughly cleaned **with pressure, with a lot of water and active substances** (surfactants) by applying a high-pressure machine.

The disinfecting efficiency is ensured by a thorough cleaning, i.e. potato rests obturating surface pores and capillaries must be removed, to uncover the occlusions under the coating, to a very large extent.



The rest coatings, normally hardly water soluble, are partially dissolved by the lipophile surfactant head group, and becomes water-soluble by the action of the hydrophile portion, and is, then, rinsed off together with the detergent solution / waste water.



## Activity decreasing factor - restwater



- Cleansing water and rest moisture from rain  
Examinations at rough, untreated wooden boxes:
- Water content 8 mass-% after drying
  - Afterwards dipping of wood pieces into water  
⇒ Increasing up to 30 mass-% water content



**Up to now:** Boxes are stored outside  
after use - sun and rain should reduce  
the germ contamination.



**But:** Rests of dirt are protecting Bacteria and Fungi and they will not be killed!  
By this procedure, duration forms of Fungi will be killed never!

**On the other hand:** Wooden boxes content a big volume of water after long rain phase.

After cleansing **wooden surfaces resp. concrete surfaces must dry of (concrete till grey shining).**

These rough materials contend cleansing- and rainwater.

Otherwise, the product-solution will be diluted by this rest-water.



# Application of Disinfectants



## with high-pressure machines

- Pre-mixed solutions self-made (out of 200 l barrels)

## with Plant protection sprayer

- by spray-technique or by connection of hose

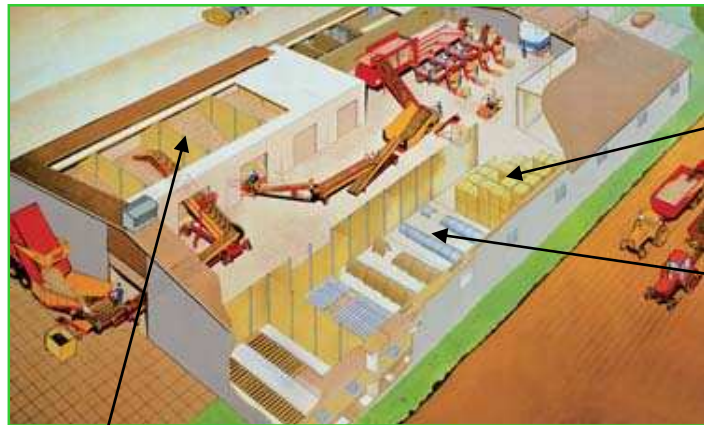
## with MENNO<sup>®</sup> Disinfectant applicator

- For connection on a hose with a snap connector
- For automatically exact dosage of product
- Foam to guarantee longer contact- and exposure times at vertical surfaces
- Foam as a spray control for application
- Foam – for protection of workers (wind drive off)





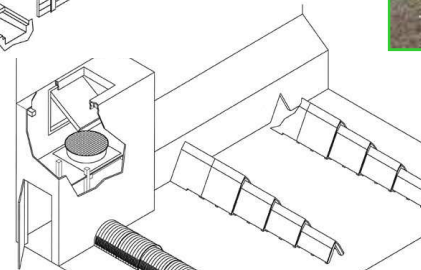
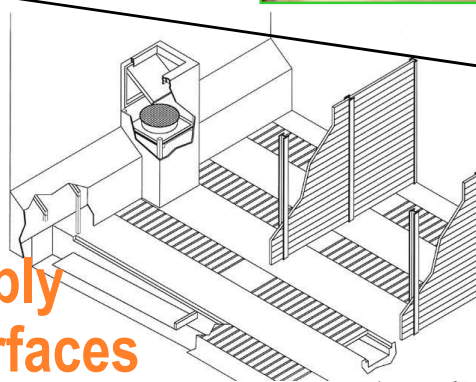
# What must be disinfected – surfaces of warehouses



**Boxes, warehouse-/store-surfaces, partitions, ventilation systems and -canals,...**



**General all possibly contaminated surfaces in the surrounding of warehouses:**



**Do not forget - the complete ventilation system!**

Spores and duration forms can survive without an effective disinfection and they would spread into the new store.

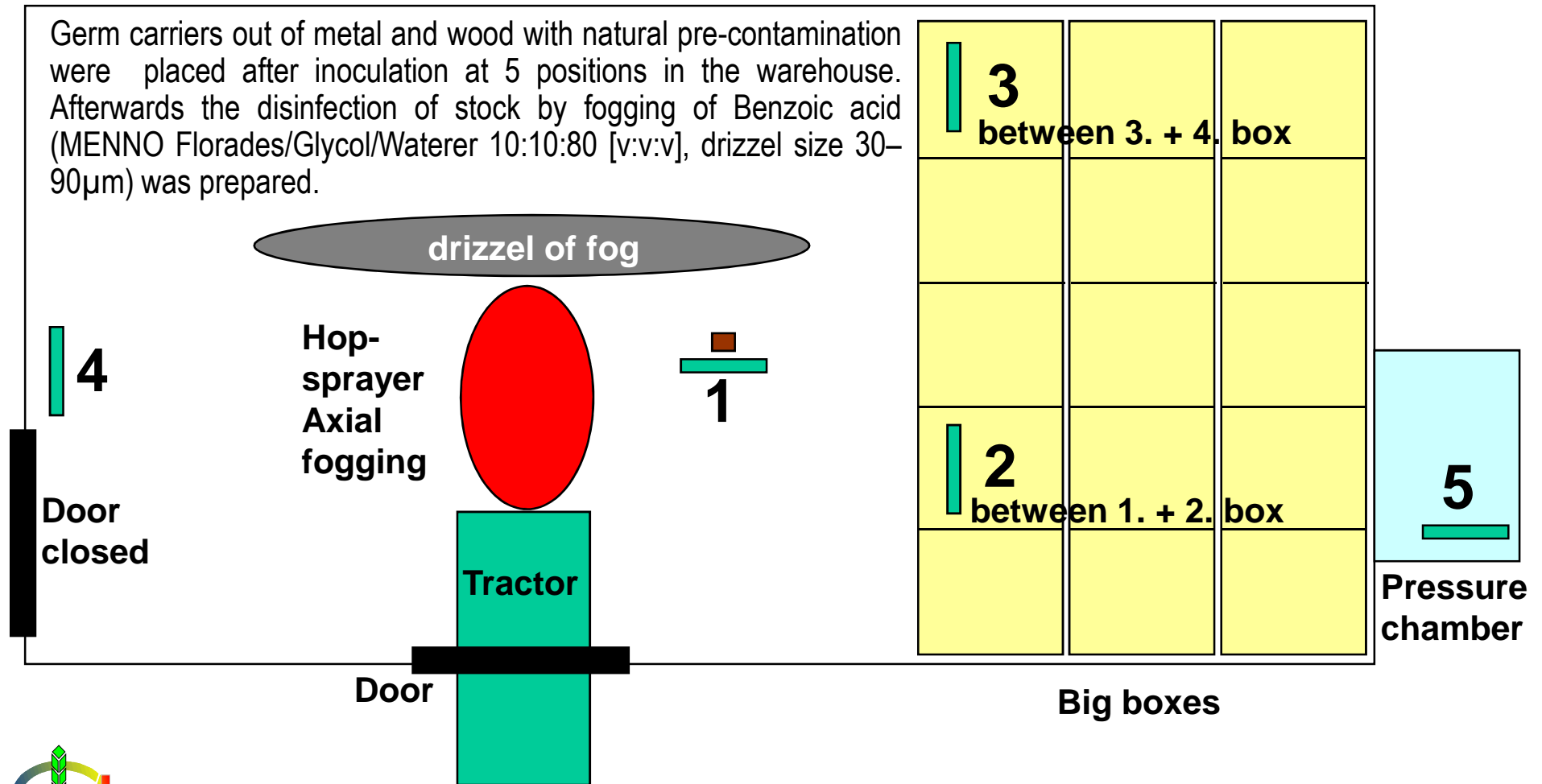




# Disinfection warehouse Agarthenburg 2002 (02 M 04)



Question: Is fogging inside a stock possible - with presence of boxes ?



Position germ carriers: 1 - 5



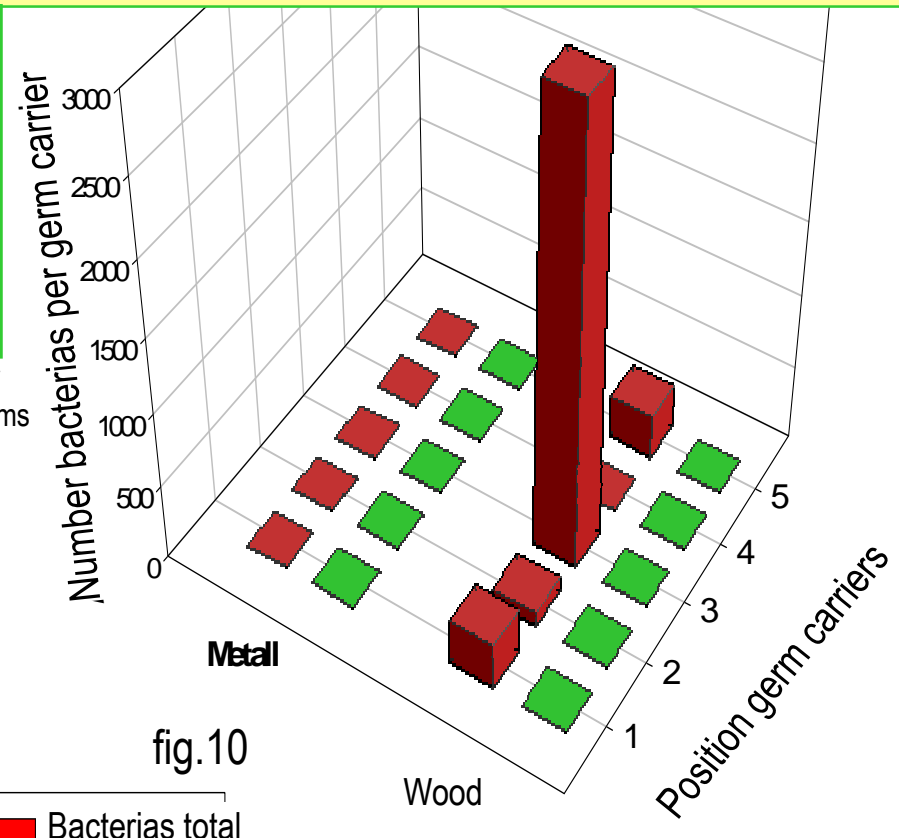
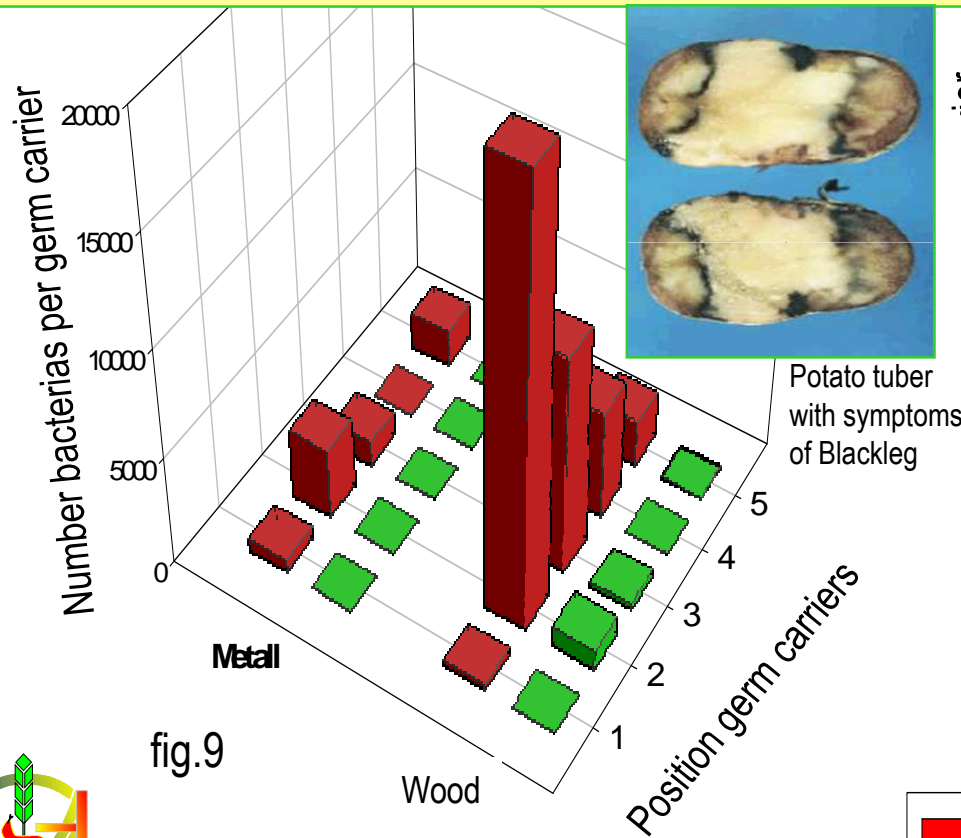
# Disinfection warehouse Agarthenburg 2002 (02 M 04)



**Inoculation with Erwinia**  
(Examination directly after disinfection)

**Inoculation with Erwinia**  
(Examination 1 day after disinfection)

It can be confirmed, that in case of contact with drizzels of fog at (position 1 + 4), MENNO Florades had a high effectiveness against bacterial germs. The most surviving bacteria was found on the wooden germ carriers at the difficult reachable positions 2 + 3 (fig. 9).





# Disinfection warehouse Agarthenburg 2002 (02 M 04)



**Inoculation with Silverscurf**  
(Examination direktly after disinfection)

**Inoculation with Silverscurf**  
(Examination 1 day after disinfection)

**MENNO Recommendation:** The „wet“ disinfection with a big volme of solution by contact to the relevant surfaces is having the best effects and guarantees the success.  
A Fog is not sufficiently for difficult reachable areas, especially when boxes are placed inside the warehouse for the disinfection.

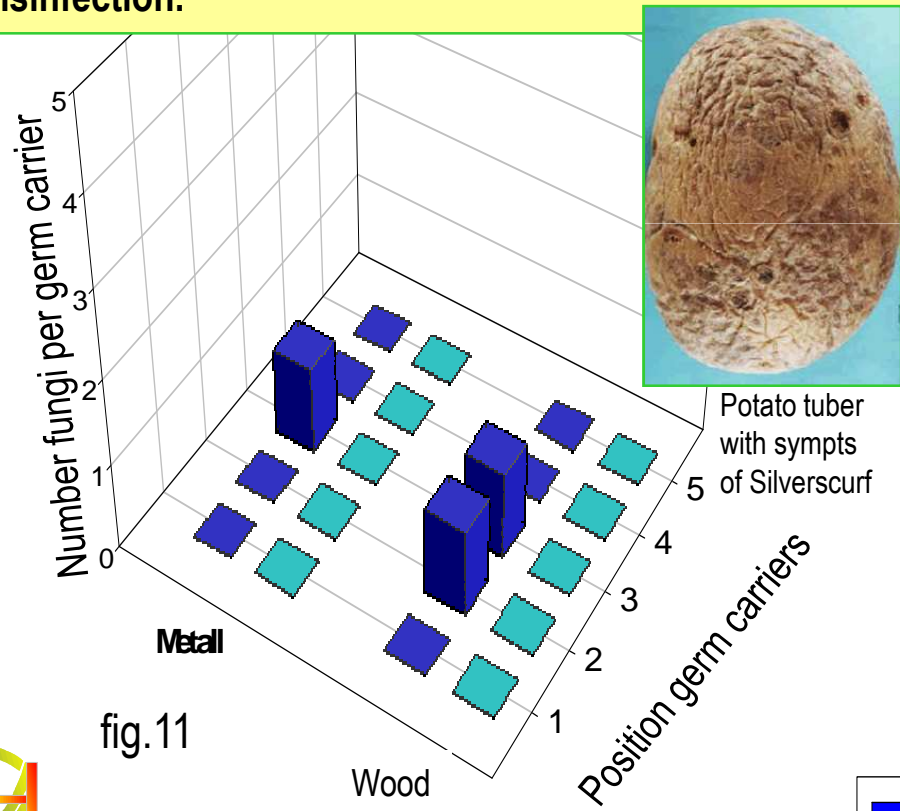


fig.11

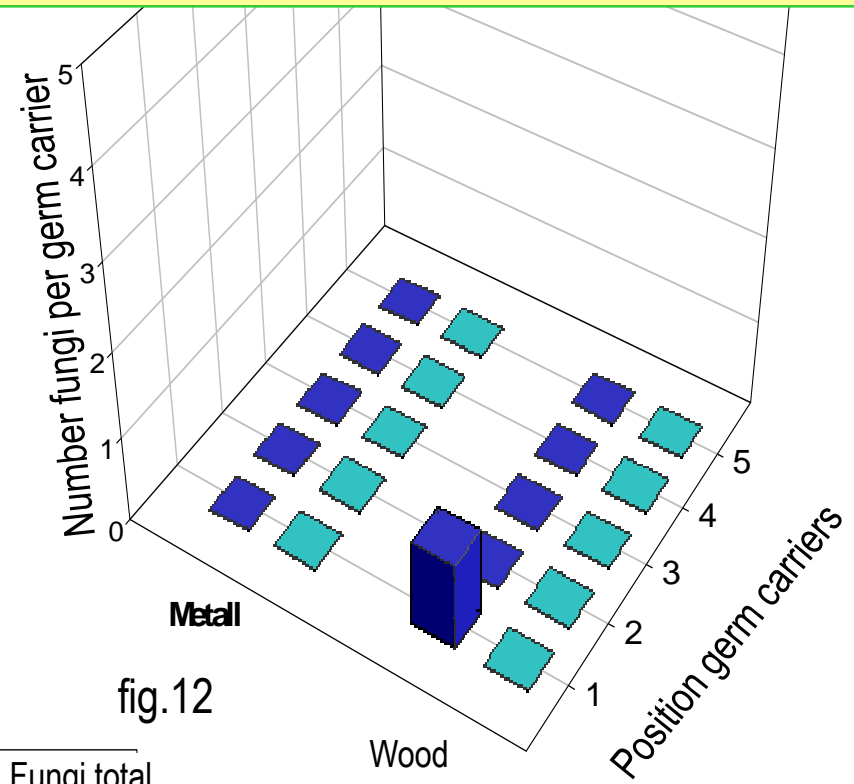


fig.12

■ Fungi total  
■ Silverscurf





# What else must be disinfected – equipment and machines



### Planting technique



### Planting machines

**Before put into a new field resp. after use - disinfection!**

In this case the disinfectant solution can be directly taken in the tank!

Plant protection sprayers must be disinfected after use also.

But, during the harvest this machines are not in use and can provide the disinfectant solution for transport- and harvest technique.



### Harvest techniques



### Transport surfaces and tractors



Do not forget the tires



### Receiving Hoppers



### Conveyor Belts

### Box Fillers



### Store Loaders



### Separators



### Sorters



### Sack filling machines





## Perspectives in the future – Treatment of potato tubers



Examination of treatments against e.g. Silverscurf at the moment of storing.

Such treatments could be carried out with e.g. MAFEX/Mantis

or

Microstat (electrostatical load).

Treatment on:

Roll- and sort tables

Enterdern

Förderbändern o.ä.



Such treatments require a registration and are not permitted yet!