

Non-chemical seed treatment

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Seed health



Avoiding crop diseases:

- Resistance of crop
- Production of healthy seeds
- Sorting of seeds
- Eradication of pathogens
- Buffering of the soil

Head blight in wheat

- Head blight (scab) in wheat can be caused by several fungi:
 - *Fusarium graminearum*
 - *Fusarium culmorum*
 - *Microdochium nivale*
- The fungi can also cause seedling death



Photo by Vernyl Pederson



Marcia McMullen



Photo by Bart Timmermans

Head blight in wheat

- Seeds are obliged to be tested for 'Fusarium' infection, by inspection services
 - In the Netherlands: NAK
- General rule:
 - Heavy infection: no surviving seedling
 - Low infection: one third gives no surviving seedling
- Seedling survival is also dependant on environmental conditions
 - Low soil temperatures gives less survival
- Genetic variation in seedling survival?



Production of pathogen-free organic seed

■ Prevention

- hygienic measures
- date of sowing and harvesting
- supply of nutrients
- avoidance of rain during seed maturation
- physical exclusion of pathogens (green houses)
- application of antagonists during seed production
- etc.

Production of pathogen-free organic seed



Model:

carrot – *Alternaria*

Researchers:

Cees Langerak and Carin van Tongeren (WUR)

Alternaria radicina can be transmitted through the seeds

“Damping off”



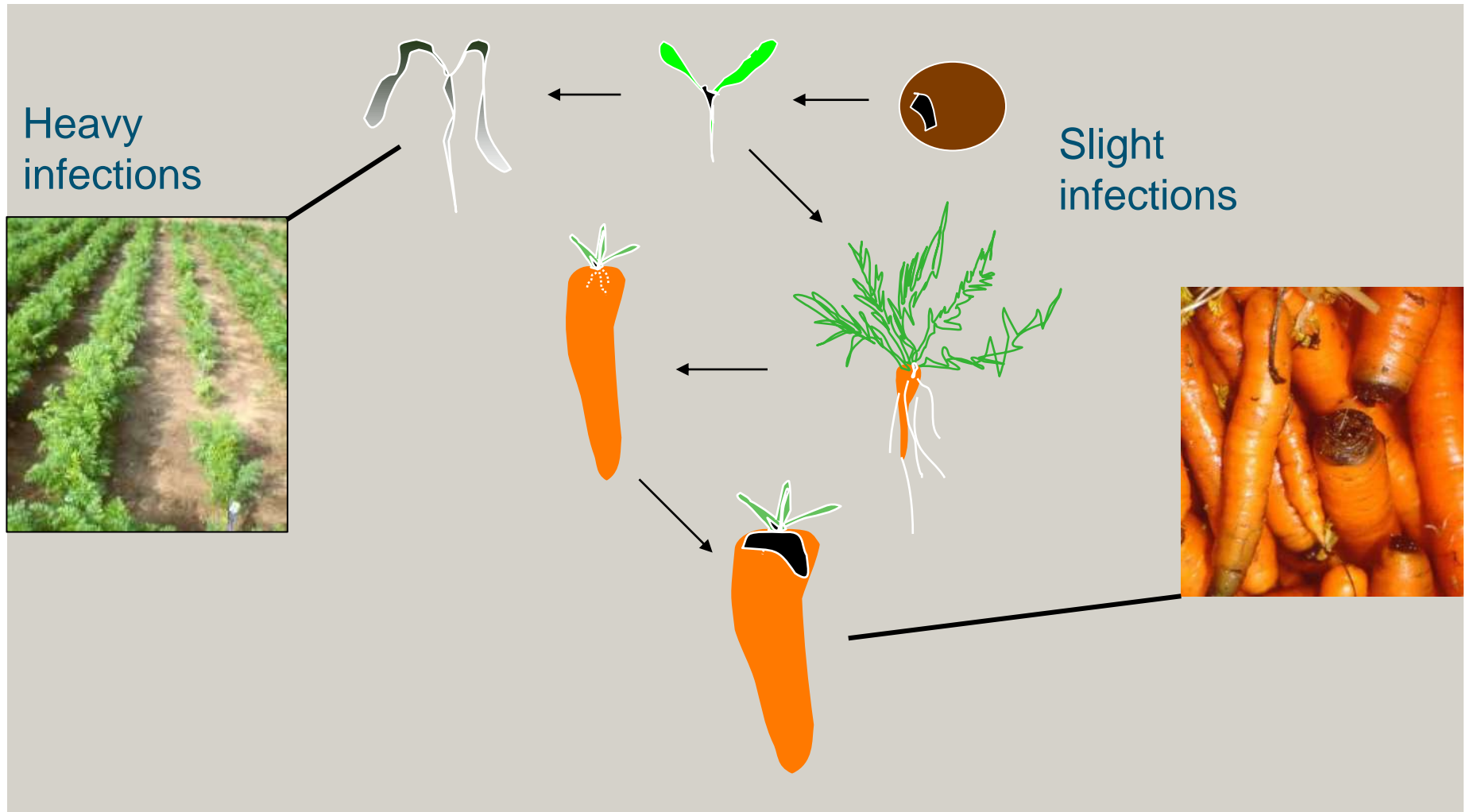
Hot water
treated

Non-treated

“crown-rot”



Transmission of *Alternaria radicina* through the seeds



Seed health and seed production

Model:

- *Xanthomonas campestris* pv *campestris* (Xcc) – black rot
 - Researchers: Jan van der Wolf and Patricia van der Zouwen (WUR)
- How to avoid seed contamination?
- Prevention
 - Sanitation treatments
 - How is the bacterium transmitted?

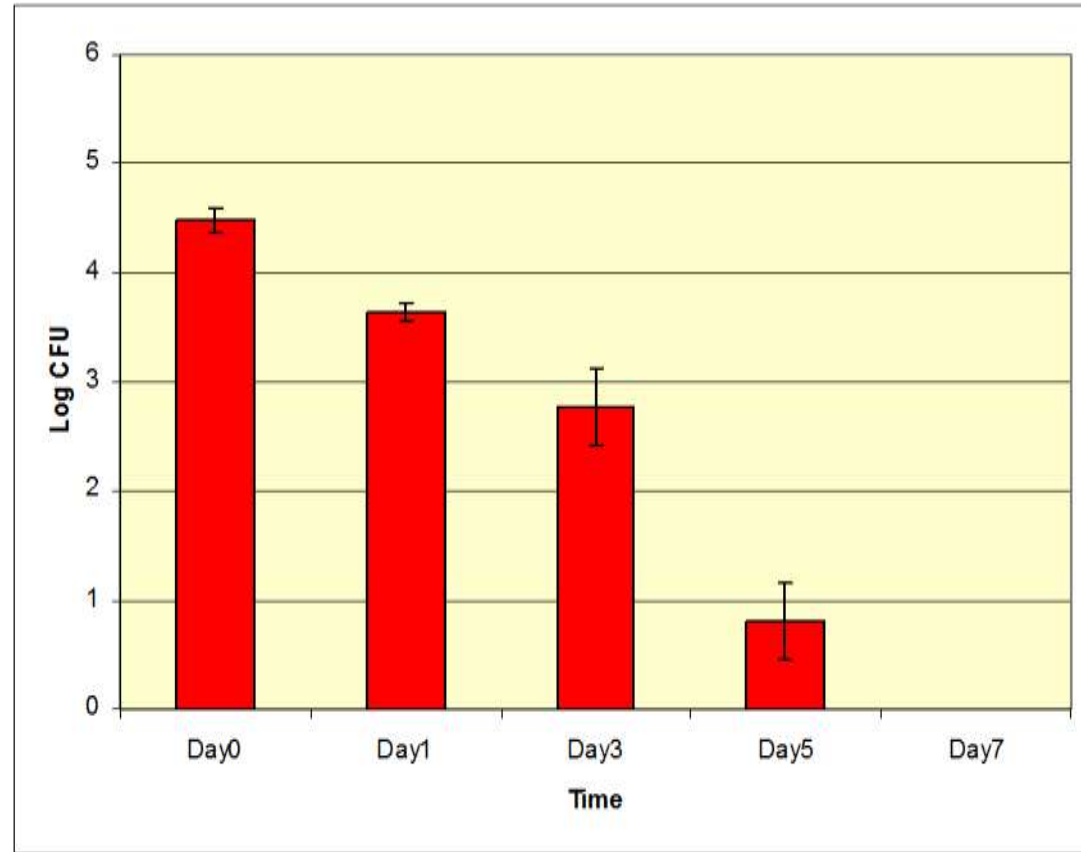


Prevention of seed contamination

- Critical points for controlling *Xcc* in cabbage seed production
 - Role of flower infections in (internal) seed infections
 - Role of pollinating flies in transmission of *Xcc*



Prevention of seed contamination

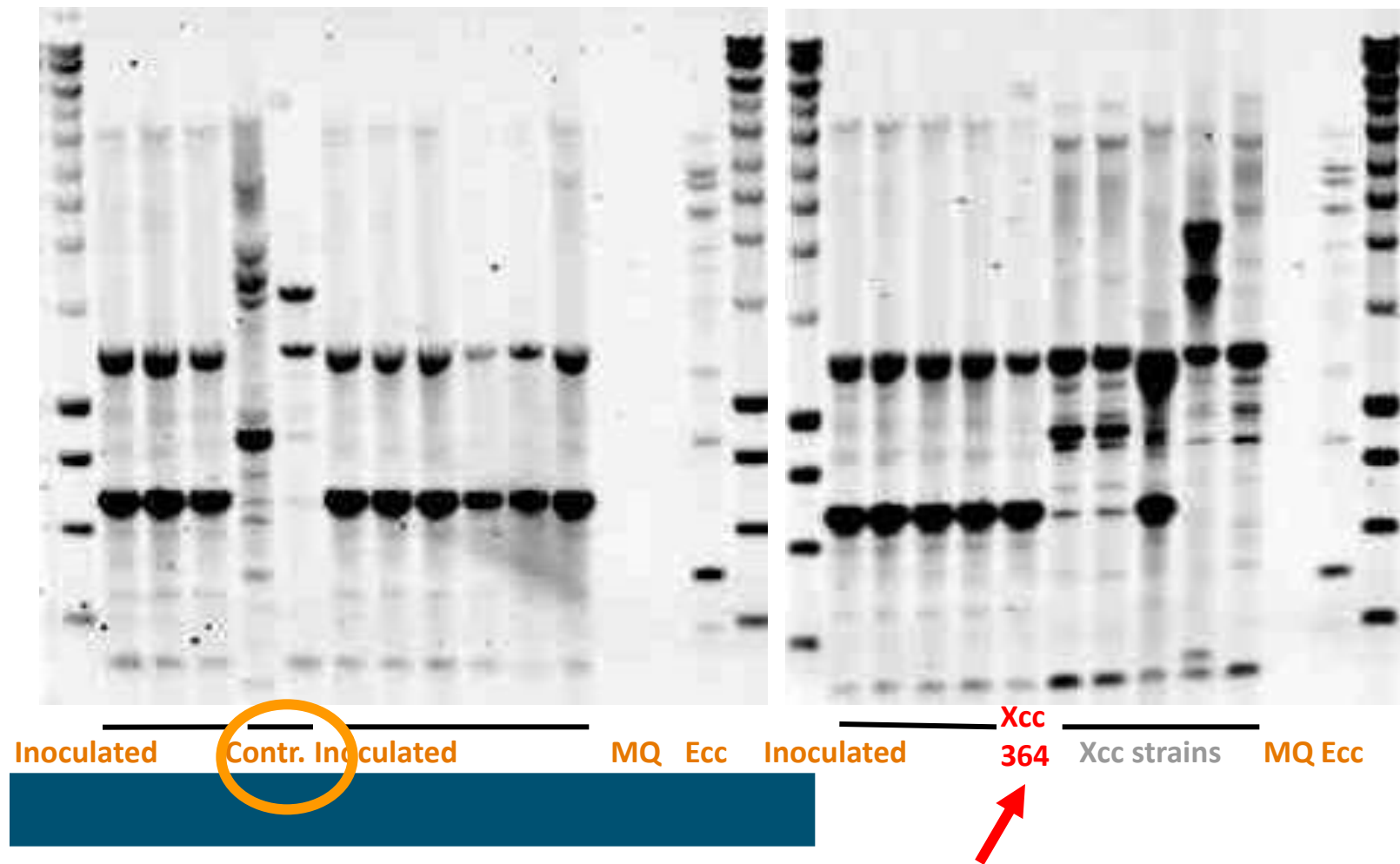


Xcc survives for up to five days on flies

Flower infection results in seed infection

	Cfu/ml (100 seeds/ml; 100-1000 seeds sampled)		
Treatment	0	10-100	10000 - >1000.000
Cv. A			
Fly inoculated	9	5	6
Brush inoculated	5	6	9
Control	17	3?	0
Cv. B			
Fly inoculated	13	6	1
Brush inoculated	9	5	6
Control	16	2?	0

Confirmation isolates with BOX-PCR 2005



Seed health and seed production

Xcc:

- Basic seed can be a source of seed infection
- Insects can transmit diseases from neighbouring infected plants (can also be weeds)
- Crop debris can be a source of infection
- Contained seed production might help



Eradication of seed borne pathogens

- Eradication by non-chemical treatments
 - Biological treatments
(micro-organisms, phages, etc.)
 - Chemical treatments with 'green chemicals':
 - active compound is of natural origin and not chemically processed
 - active compound is minimally purified from crude extract
 - physical treatments
 - hot water
 - heat
 - radiation

Sanitation with natural compounds

- Compounds should be allowed according to national (EU) regulations
 - Human and eco-toxicity
- Not phytotoxic
- Treatment costs should be low
- For organic farming the compounds should be allowed
 - EU regulation 2092/91

Treatments with green chemicals

Groups of green chemicals:

- plant- (and animal extracts): onion extract, chitosan
- essential oils: neem tree oil, thyme oil
- anti-microbial proteins: nisin, lactoferrin
- other natural antibiotics:
chelators, detergents, elicitors

Sanitation with natural compounds

Research performed by
Jan van der Wolf, (WUR):

- Emulsion of essential oils
thyme, oregano, clove, ...

- Organic acids

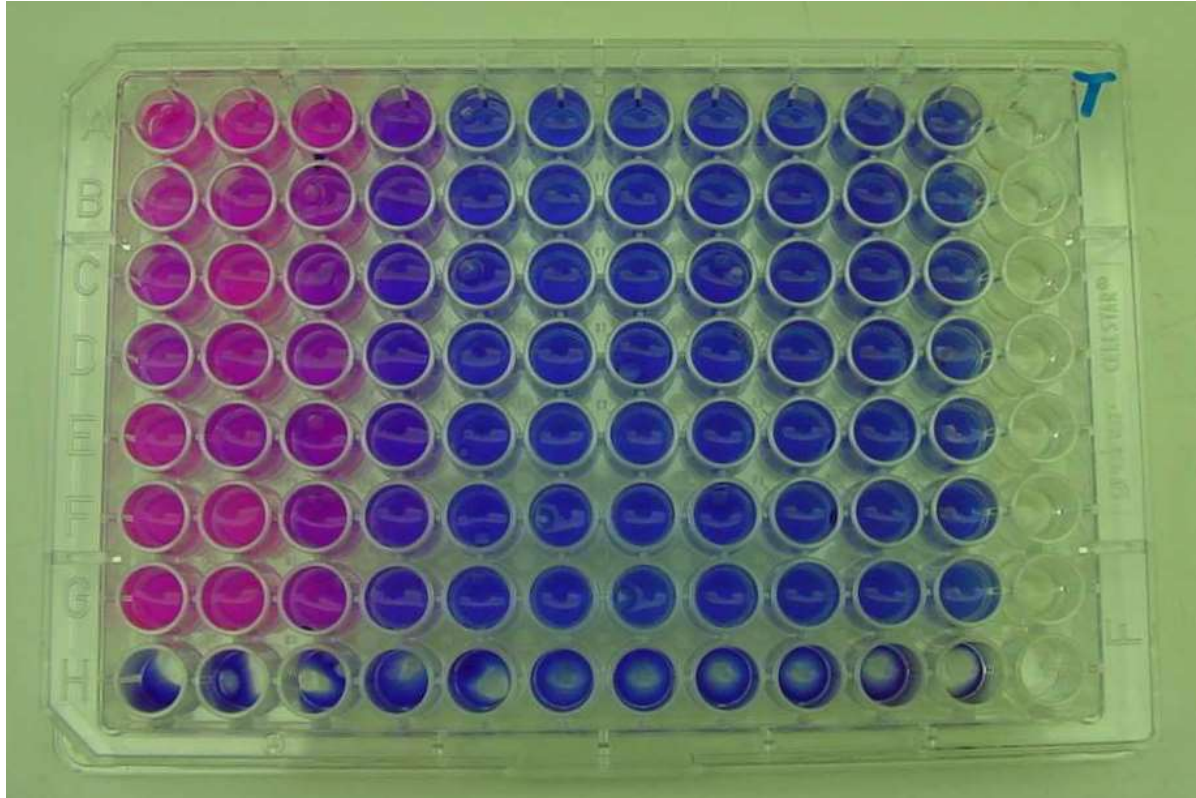
Acetic acid (vinegar), lactic acid, ascorbic acid,



Choice for essential oils

- Classified within the Dutch regulations “Exception crop protection agents”
(Essential oils are only allowed for pouring, dipping and drenching (at present not for fumigation))
 - No extensive registration is needed
(some are GRAS compounds (Generally Recognised as Safe))
 - Agents with low risks for limited use (e.g. organic agriculture)

Essential oils effects on bacteria



Essential oils effects on bacteria: Microplate assay with resazurin, pink = actively growing bacteria

Seed sanitation by physical methods

- Hot water treatment



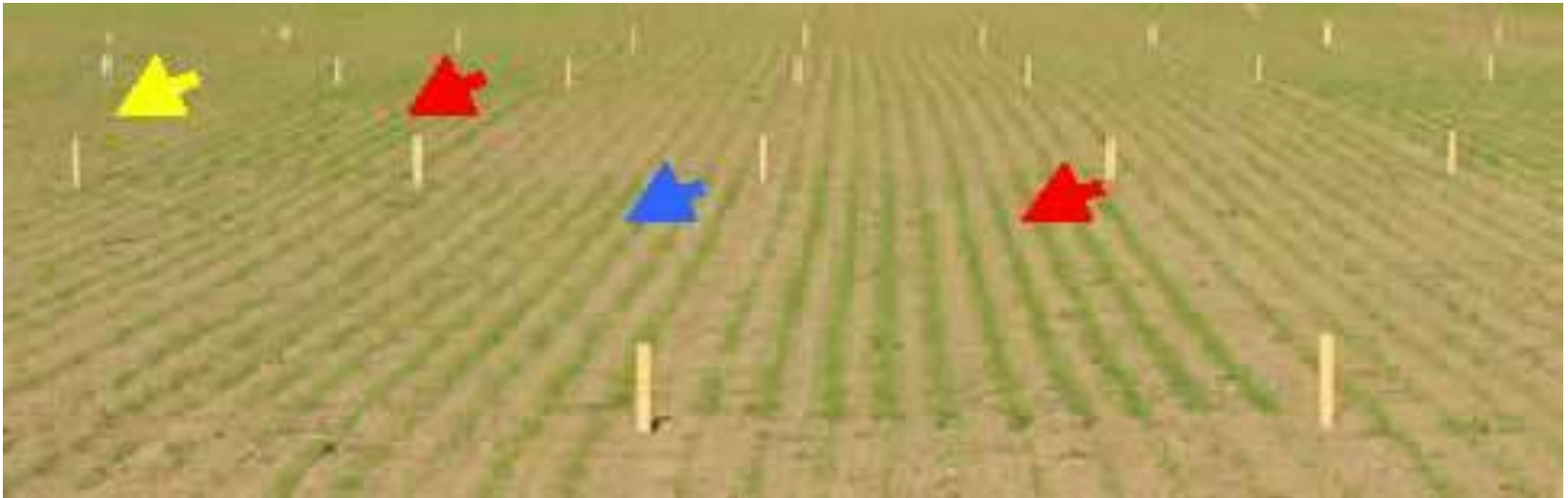
Source: http://www.seedprocessing.nl/media/495_3271.20.00-Zaaddesinfectieunit-klein.1.jpg

Seed sanitation by physical methods

Aerated steam treatment
ThermoSeed



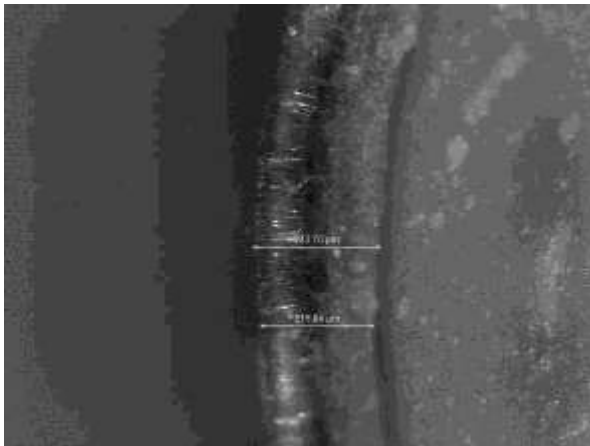
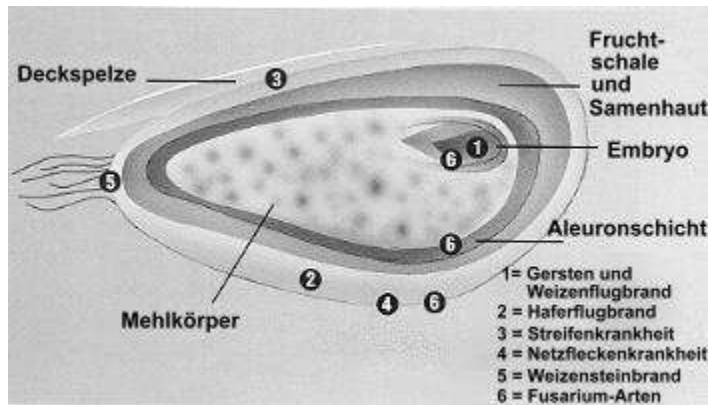
ThermoSeed™ treatment with wheat seeds



Commercial ThermoSeed™ treatment unit

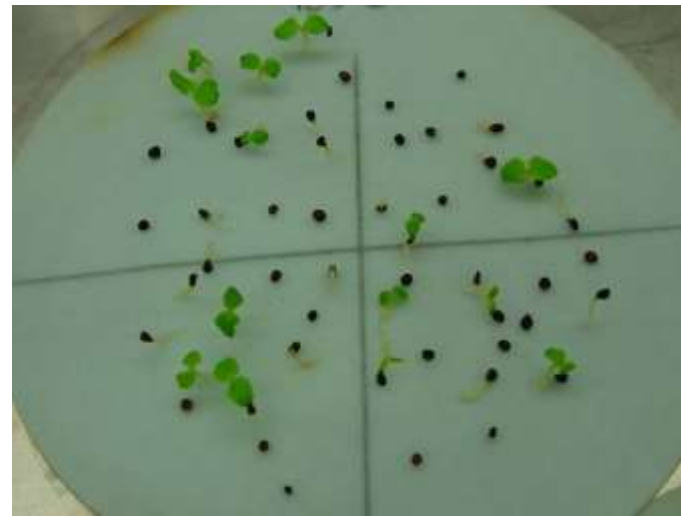
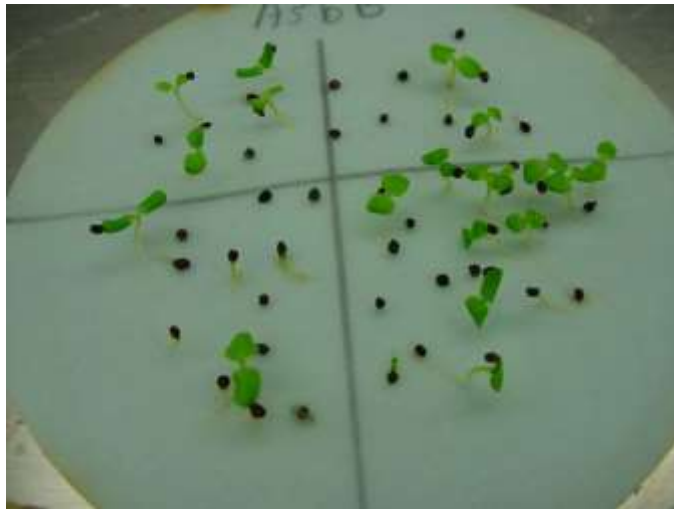


Electron seed treatment (e-dressing)



Physical seed treatments

- Balance between seed and pathogen for sensitivity towards physical treatments

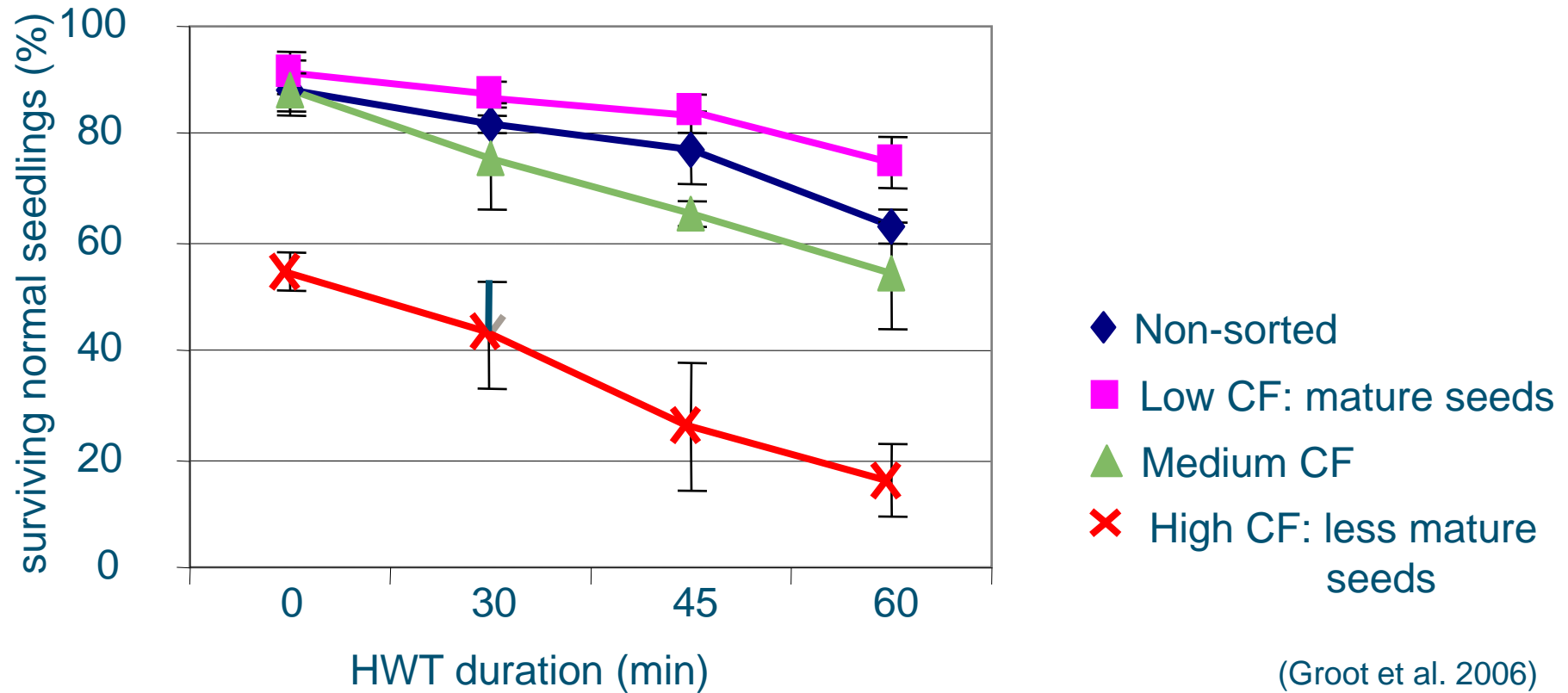


Physical seed treatments

- What determines seed sensitivity to physical treatments?
 - Crop
 - Variety
 - Seed moisture content
 - Seed maturity?
 - Seed 'priming'?

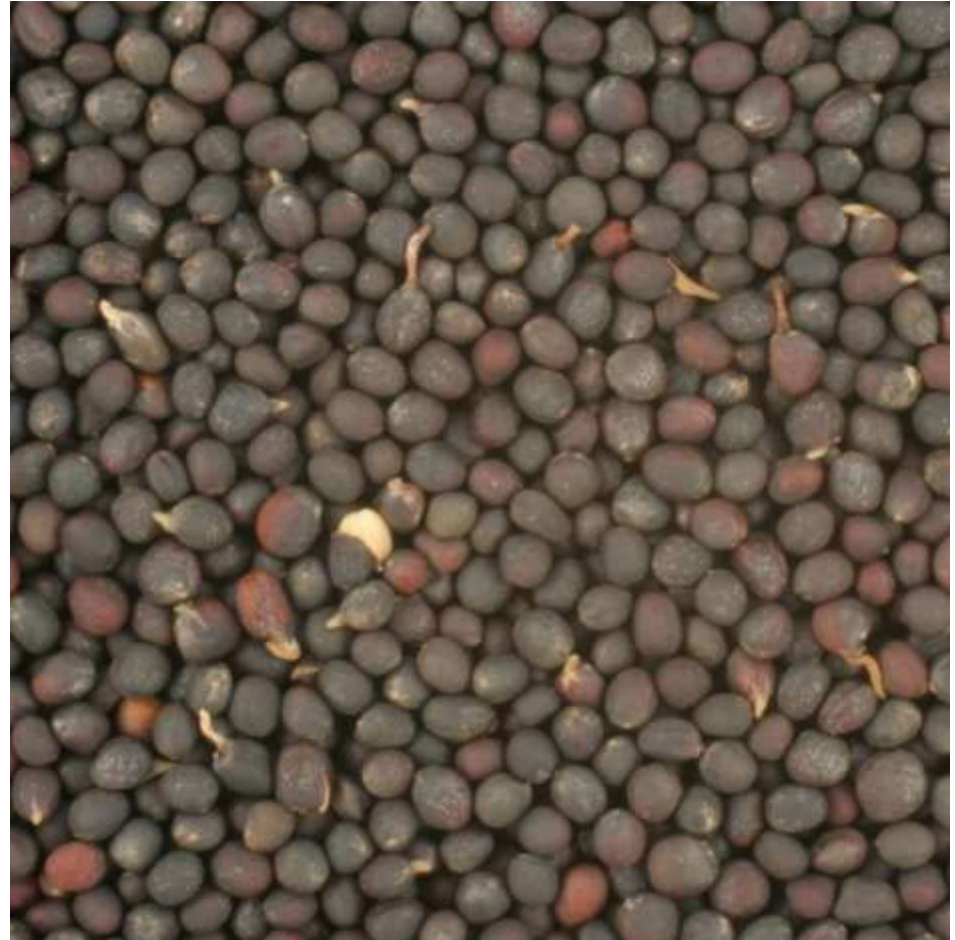
Sensitivity of cabbage seeds to hot water treatments

percentages



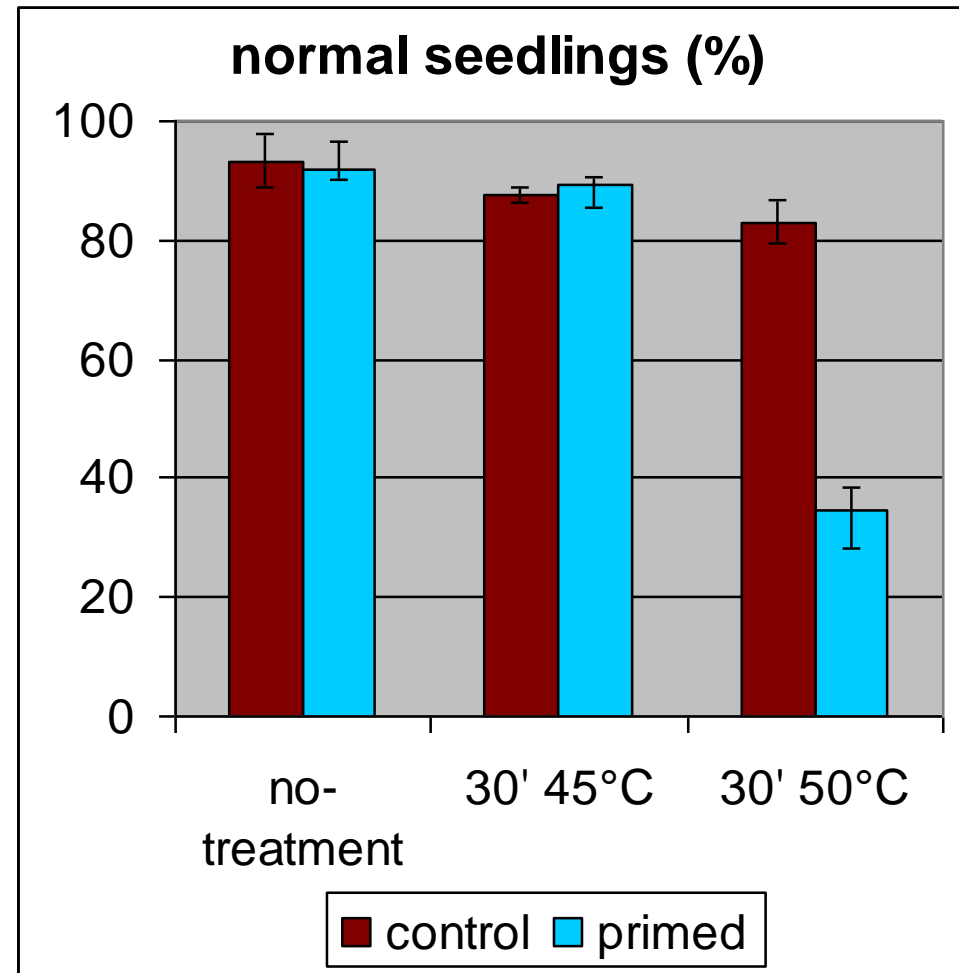
Effect pre-germination on sensitivity

- Seeds may start germination processes prior to harvest
- Are these seeds more sensitive to physical treatments?



Effect pre-germination on sensitivity

- Pre-germinated seeds are more sensitive to hot water treatments
- Pre-germination is not always visible by eye, markers are needed



Contact

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