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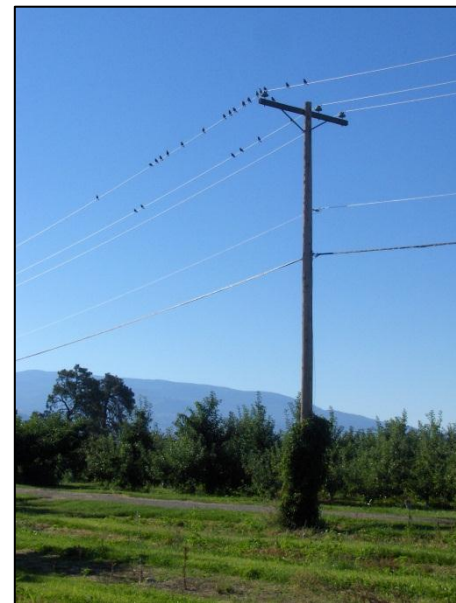
# **Seed disinfection: have all options been explored?**

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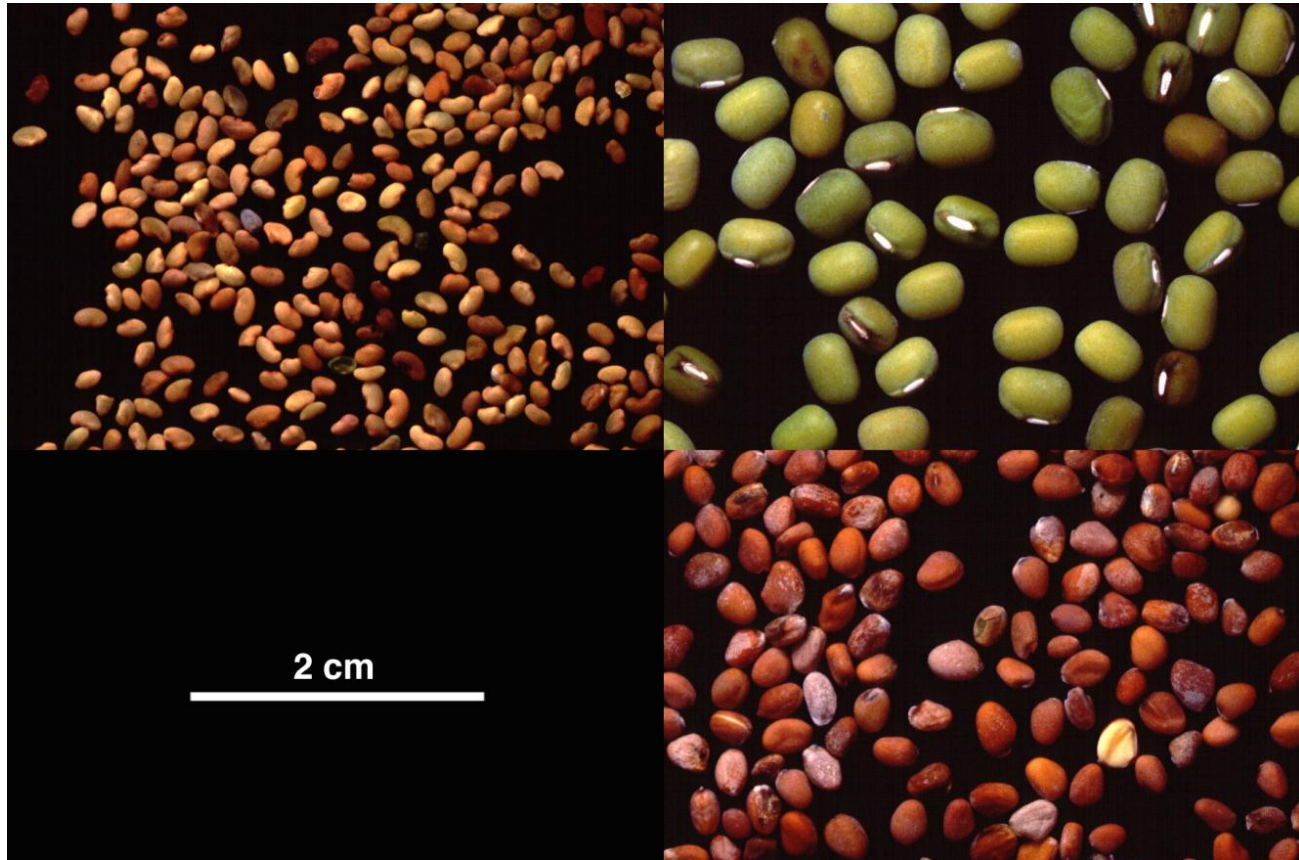
# Is it possible to produce pathogen-free seed?



**Not likely....**

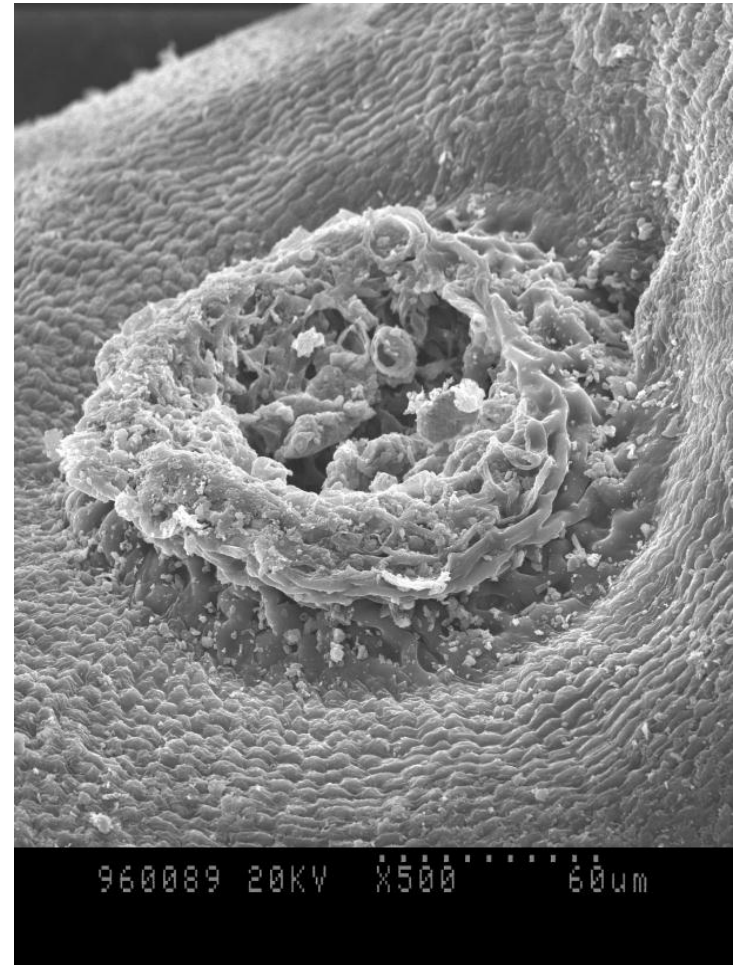
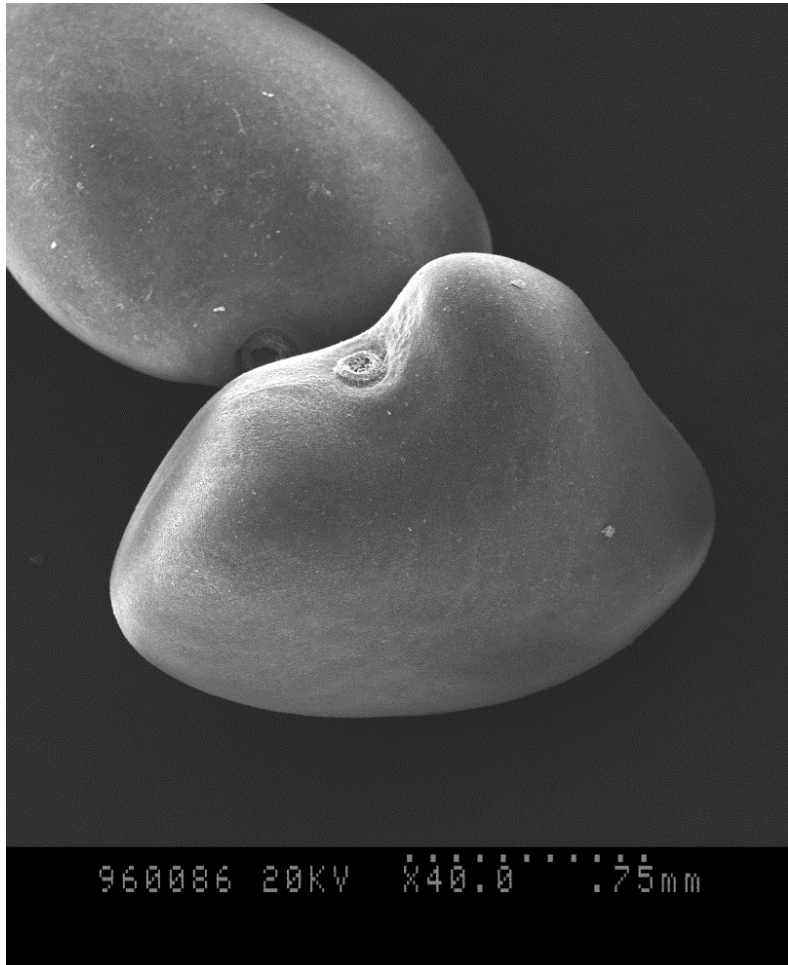


## *The problem:*



**Different sizes, shapes, vigor, resistance to disinfection**

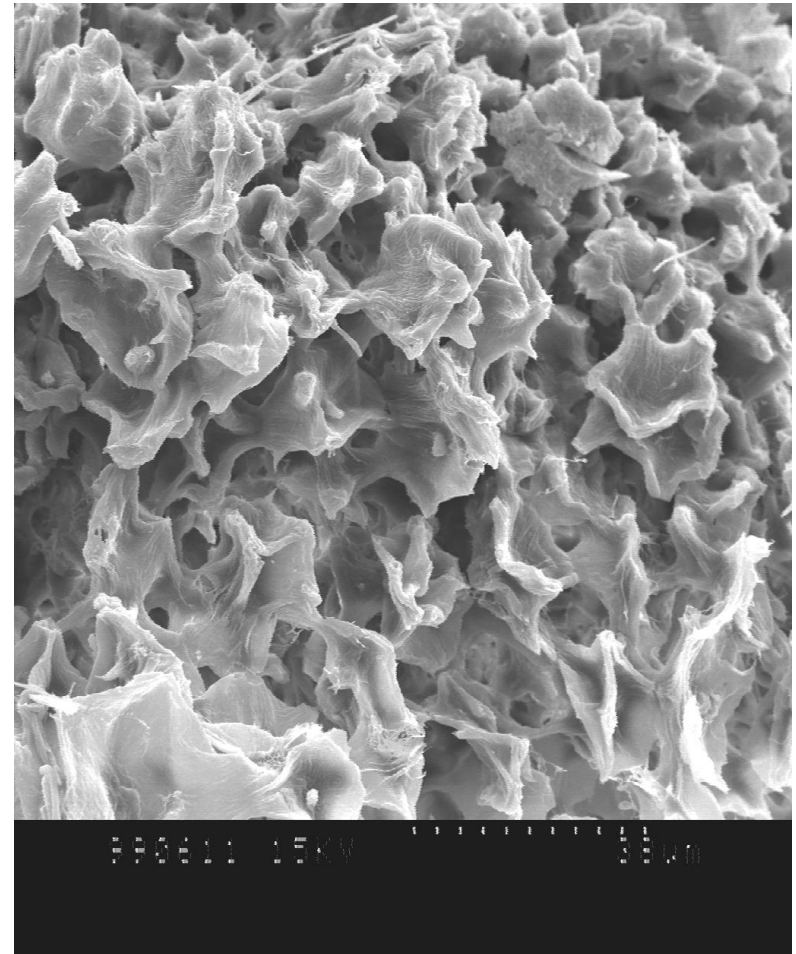
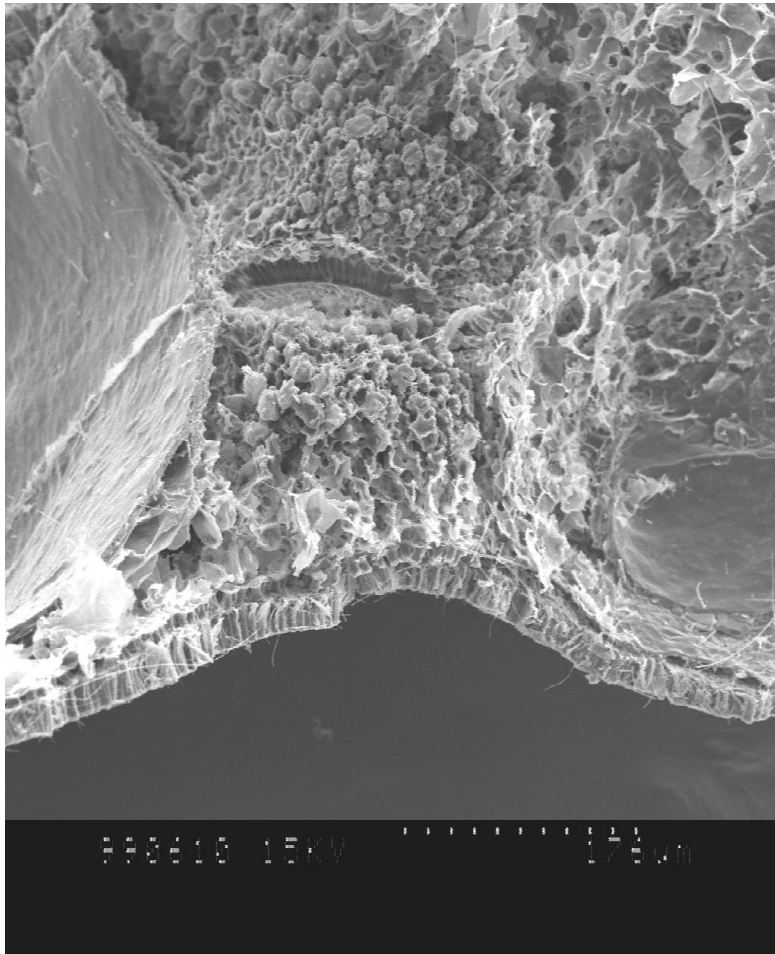
## Seeds up close.....



**Alfalfa**

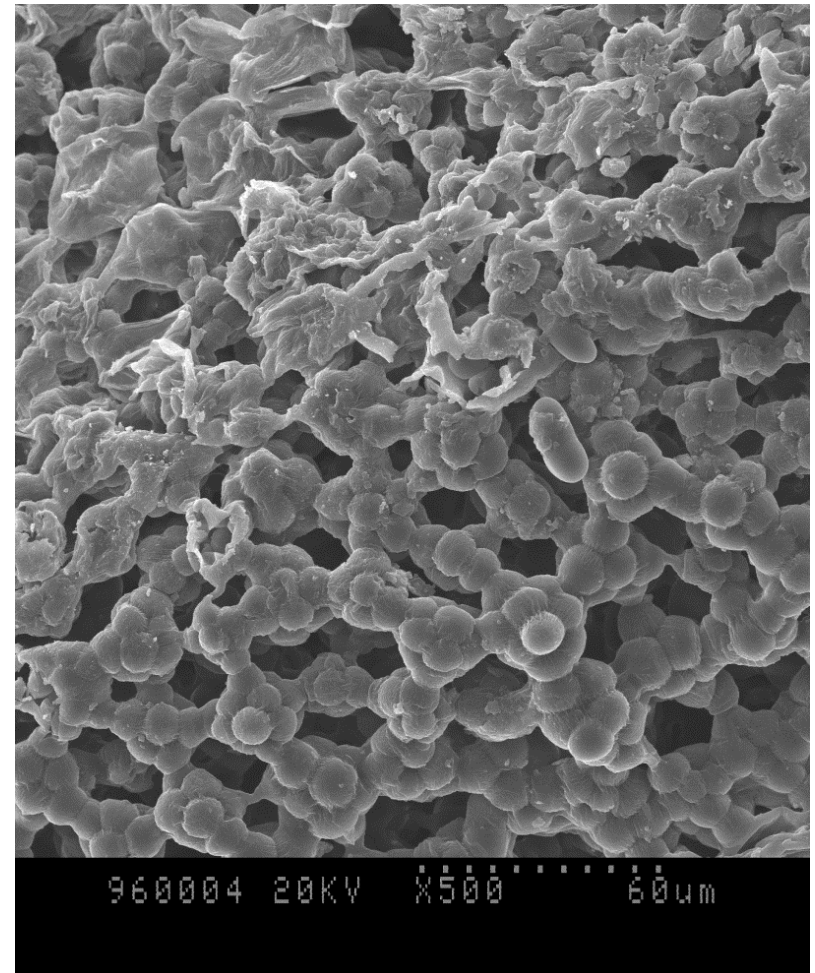


# Seeds up close.....

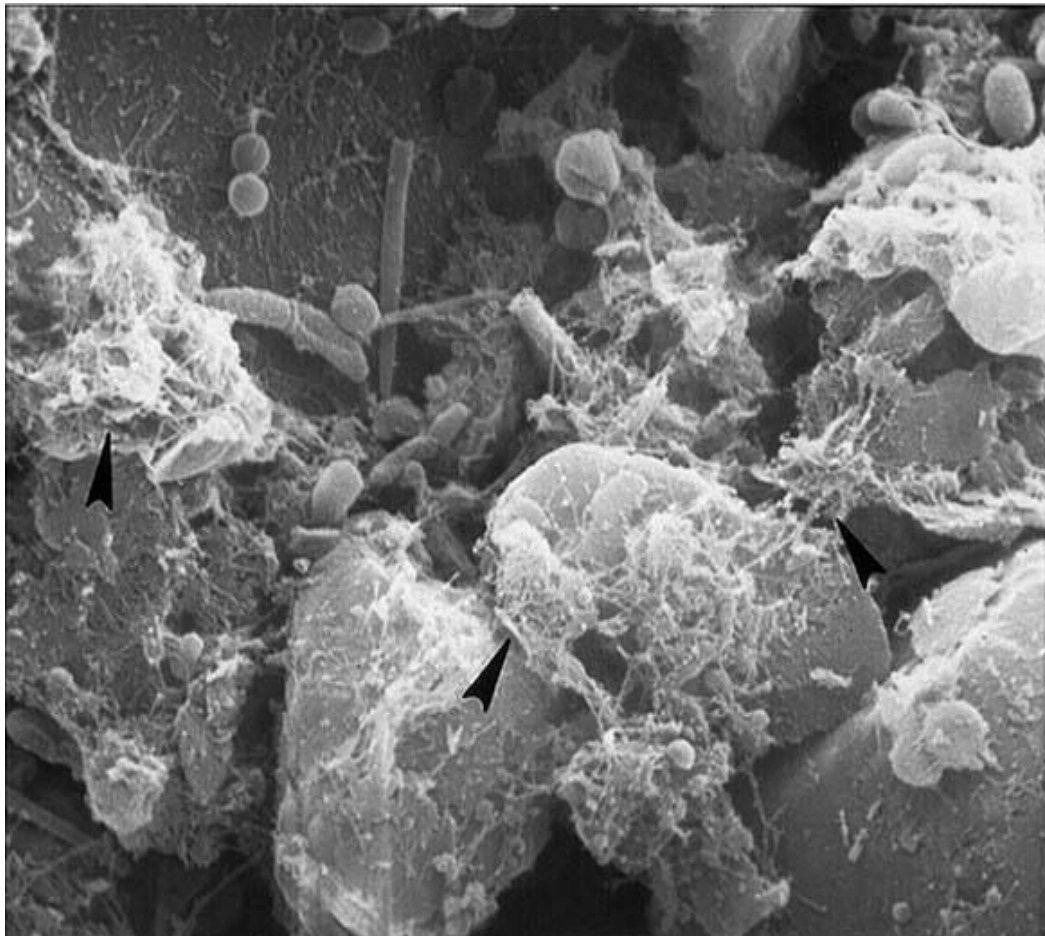


**Alfalfa**

## Seeds up close.....



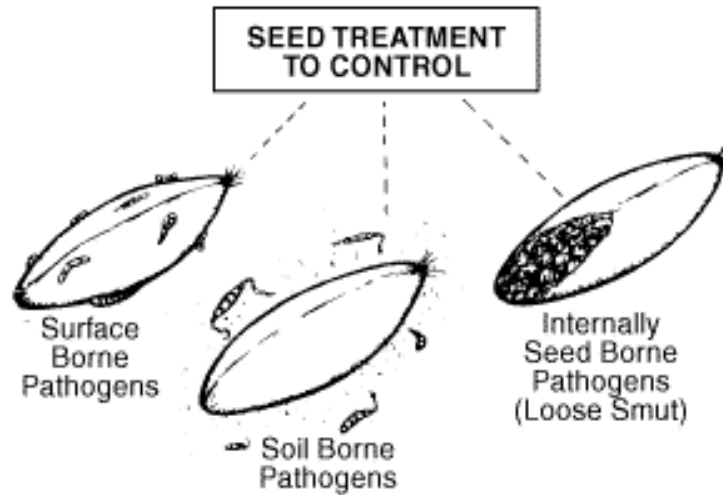
**Mung**



**Bacteria attached to the surface of plant tissue**



# **Industrial seed treatments**



- Purpose is to control plant pathogens
- Chemicals used depend on seed type, target microorganisms, regulations
- Tend to be toxic compounds, seed cannot be used for food use



## An alternative:

- Irradiation using gamma rays, electrons
- Advantage: treatment can penetrate the seed
- ....but cost and other issues hamper application



## Another alternative:



**ThermoSeed™, Incotec.**

- Hot humid air, very short exposure times
- Treatment is effective against internalized pathogens
- Effective against foodborne pathogens?

## **Disinfection of sprouting seed:**

- **Recommended treatment: soaking in chlorinated water solution, 20,000 ppm (US) or 2,000 ppm (Canada)**



- **Not 100% effective**



## **Alternatives that have been investigated:**

- **Other chemicals – hydrogen peroxide, alcohols, peroxyacetic acid, organic acids, surfactants, other sanitizers, “natural” antimicrobials**
- **Disinfection using gases**
- **Mild heat, either dry or wet**
- **No reliable, validated, single step seed disinfection treatment has been developed to date**



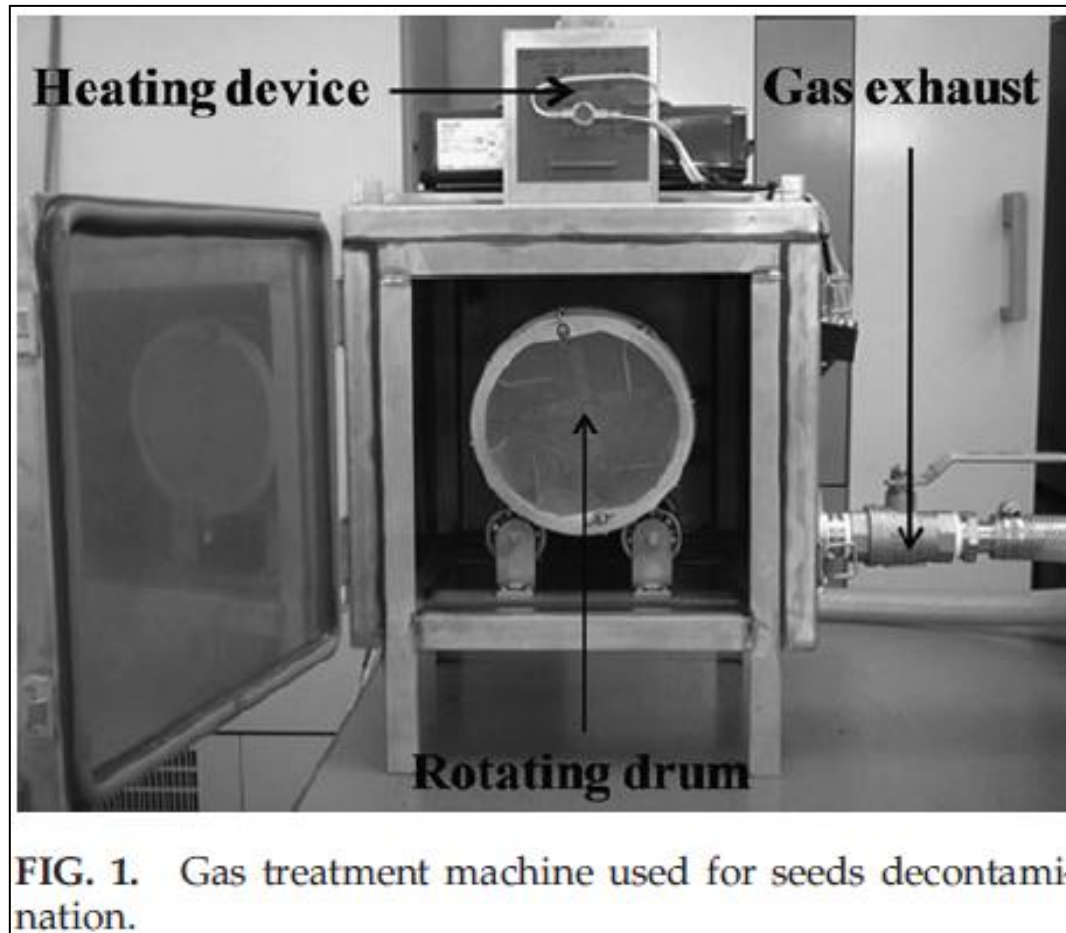
# Disinfection using gases

## Acetic acid



- Effective against *Salmonella* and *E. coli* O157:H7
- Mung bean germination rate not affected, but alfalfa reduced by 30%

...but successful disinfection of alfalfa and radish seed without affecting germination rate was described recently



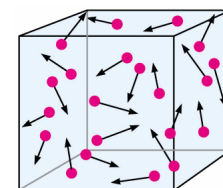
Nei et al.2011. Disinfection of radish and alfalfa seeds inoculated with *Escherichia coli* O157:H7 and *Salmonella* by a gaseous acetic acid treatment. Foodborne Pathog Dis. 8:1089-94.



## Other gas phase antimicrobials

- Allyl isothiocyanate (mustard gas), cinnamaldehyde, thymol reduced *Salmonella* on alfalfa seed treated at 50°C for 12h
- None of the treatments completely eliminated *Salmonella*
- Germinations rates reduced with increasing length or severity of the treatments

J. Food Prot. 64:442-450, 2001



## Disinfection using mild heat




**Seed Processing Holland BV**

- **In use for vegetable seed. Advantage: treatment penetrates the seed, no chemicals used**

# One company manufactures commercial equipment for heat treatment of sprouting seed

....but their own research suggests problems with germination rate and yield

- Alfalfa seed treatment: 85 °C for 9 s
- No survival of a generic *E. coli*
- Germination (73%) and yield (78.4%) less than controls

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TOP

What is "Seed Disinfecting"?

Topics

[Oct 2009\) Vol.1](#)  
[Nov 2009\) Vol.2](#)  
[Feb 2010\) Vol.3](#)  
[May 2010\) Vol.4](#)



Seeds used for sprouting is sanitized by immersing it briefly in hot water prior sprouting. This process prevents human and plant pathogens from being carried over to the growing process where they can spread easily in the warm and humid environment.

Company Info

[a bit about us.](#)  
[OUR MAIN OFFICE](#)  
[OUR FACTORY](#)  
[e-mail](#)  
Recruit

Characteristics of the method:

\*In order to use heat as a disinfectant successfully, the temperature and contact time of the seed with hot water need to be controlled very accurately. In addition, each seed needs to be treated exactly the same, otherwise the germination ability is reduced or pathogens may escape the treatment.

\*Using the latest available technology, all of our models are assuring a constant contact temperature & time. Treatment Temperatures used are above 800 C (176 F). This is above the heat resistance of Human Pathogens, such as E-coli and Salmonella.

\*The seed is sanitized without the use of chemicals harmful to the operators of the sprouting plant and the environment.

\*Heat is a natural and very effective disinfectant ? making the process suitable for organic producers.

Product Info

[Bean Sprout Growing](#)

\*Automatic and semi-automatic models are making the labor-intensive processes of seed treatment much simpler. Beside operating costs for the steam boiler and machine, there are no additional expenses (such as for expensive chemicals).

\*The method has been used in sprouting operations of all sizes in Japan for overthan ten years .



# Commercial bean sprouting equipment:



## Yung Soon Lih Food Machine Co. Ltd.

- **Washing:** Compress the air into water to stir the seeds, so that the small stalks and seeds will float on the water and easy to be removed.
- **Sterilizing:** Kill most bacteria and germs with 90° C. water in very short time.
- **Cooling:** Cool down the seeds with regular water

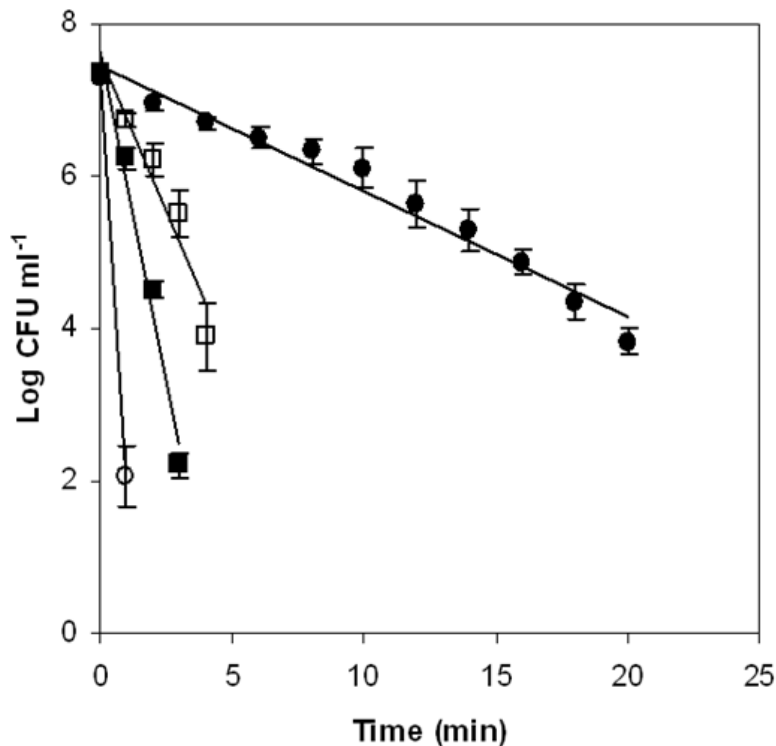
# What does the evidence say about the efficacy of mild heat against human pathogens on sprouting seed?

Treatment	Seed type	Pathogen	Reduction	Reference
Presoak 15°C 15 min, soak at 50°C and treat at 85°C for 9 sec.	Alfalfa	<i>E. coli</i> ATCC 25922	> 5 log, neg. by enrichment	Food Sci. Technol. Res., 8:247–251, 2002
Dry heat, 50°C for 17 h	Alfalfa, broccoli	<i>E. coli</i> O157:H7	> 5 log, neg. by enrichment	J. Food Prot. 72:631-4, 2009
Dry heat, 50°C for 17 h	Radish, mung	<i>E. coli</i> O157:H7	5 log, pos. by enrichment	J. Food Prot. 72:631-4, 2009
Dry heat, 50°C for 17 h followed by soaking in oxalic acid, phytic acid, ethanol	Alfalfa, broccoli, radish, mung	<i>E. coli</i> O157:H7	>5, enrichment results vary with seed type	J. Food Prot. 72:631-4, 2009

- Results vary with seed type, treatment (dry vs wet, pre-soaking), pathogen type

# Destruction of bacteria by mild heat / antimicrobials

- Approach yields good results in some food systems.  
Example: powdered infant formula



Inactivation of *Cronobacter sakazakii* at 58°C in rehydrated powdered infant formula containing vanillic acid (○), vanillin (□), and ethyl vanillin (■).



## ***Differences in the resistance of bacteria at different stages of the sprouting process***

**Seed**

- Bacterial cells are likely in a dehydrated, dormant state; more resistant

**+/- washing, soaking**

**Sanitation treatment**

- Bacterial cells re-hydrate, less resistant

**+/- rinsing**

**Sprouting**

- Bacterial cells are actively growing and dividing, least resistant stage

## **Possible strategies for disinfection at different stages of the sprouting process**

**Seed**

- Treatments have to be more severe – moist heat in combination with antimicrobials most promising

**+/- washing, soaking**

**Sanitation treatment**

- Mild heat/antimicrobials – selection of appropriate antimicrobials, process parameters, timing of application, validation required

**+/- rinsing**

**Sprouting**

- Continued application of antimicrobials in irrigation water - ?

## **Summary:**

- **The value of treatments that employ moist heat or gases should be re-assessed for bulk sprouting seed disinfection**
- **Some interesting ideas have been explored in the past ten years but a validated, alternative seed disinfection treatment that can be applied at the production level remains elusive**
- **In both cases strategies that employ combined approaches should be examined in more detail**

**Thank you very much!**





