

Steam Sterilisation

By Marten Barel

UNDP and UNIDO consultant for Africa, the
Americas.



Overview

- History of disinfection
- What is steam?
- Where to use steam?
- Why steam application?
- Techniques
- Safety and Discipline

History of disinfestation

- Soil steaming was already applied in the 1950
- Pipes had to be dugged into the soil
- Later the sheet steaming was introduced
- This was followed by drain steaming
- Today negative pressure steaming is the latest version

When is the use of steam economically feasible?

- For more high value crops like chrysanthemum and carnations.
- In special cuttings nurseries
- Substrates steaming for seeding trays, cutting trays and pot plants.

What is steam?

1. To make steam water has to be heated up to over 100° C
2. Heating 1 liter water 1° C requires 1 Kcal.
3. From 100° C to vaporization of water, requires 535 Kcal.
4. Energy consumption decreases over 100° C to 0,5 Kcal/1kg at 160° C.
5. Warmth value of water is 1 Kcal.
6. Energy capacity of 1kg steam at 101° C = 636 Kcal.
7. A condensation energy goes into the soil.
8. Steam is best value to lethal temperature of bad organisms

Note : 1 Kcal = 1.163 watt

Use of steam

- 1.6 billion cuttings is \pm 60 ha mother plants is \pm 800 ha cut flowers Chrysanthemum
 - \pm 80 Ha Amaryllis
 - \pm 30 Ha Lilies
 - \pm 20 Ha Alstroemeria
- In total in The Netherlands \pm 1000 ha of steaming
- Belgium : the same crops but only \pm 200 ha in total
- Germany, Denmark and Norway; substrates steaming for trays.
- France: soil steaming with hood system. \pm 300 ha
- Africa: nearly all the cutting nurseries use steam



Steaming in glass house for chrysanthemum flowers





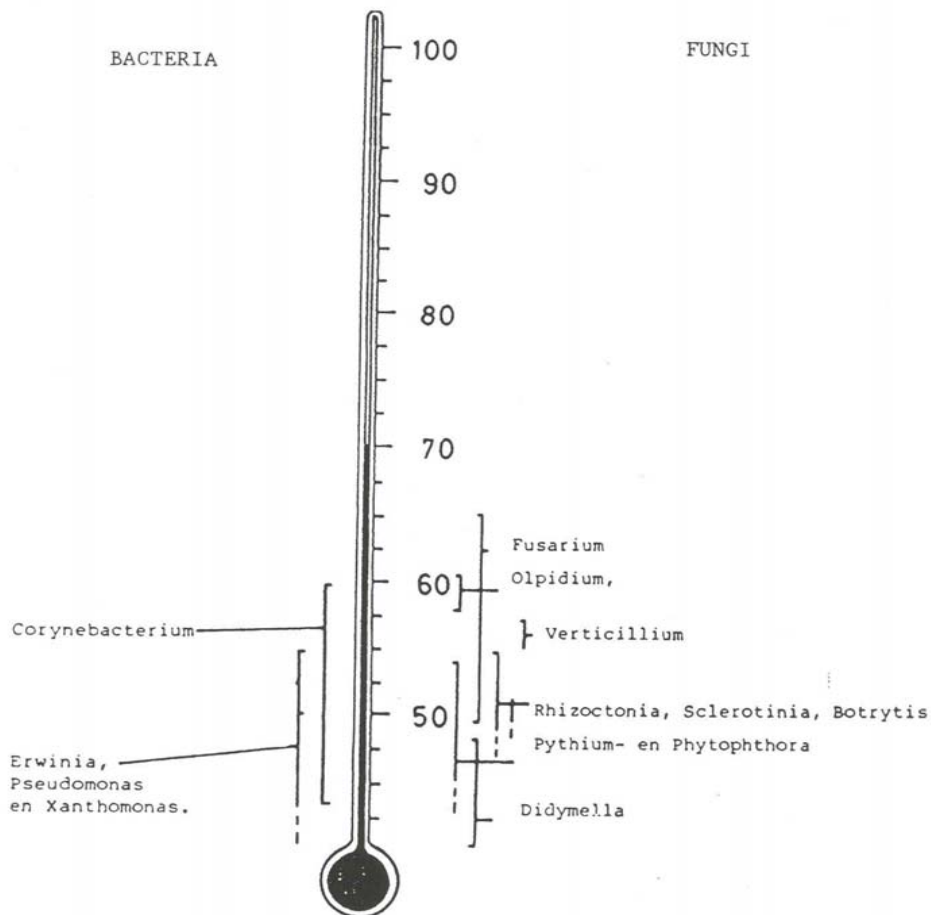
Why steam application?

**TREATMENT OF SOIL DURING 30 MIN. ON 70° C
KILLS:**

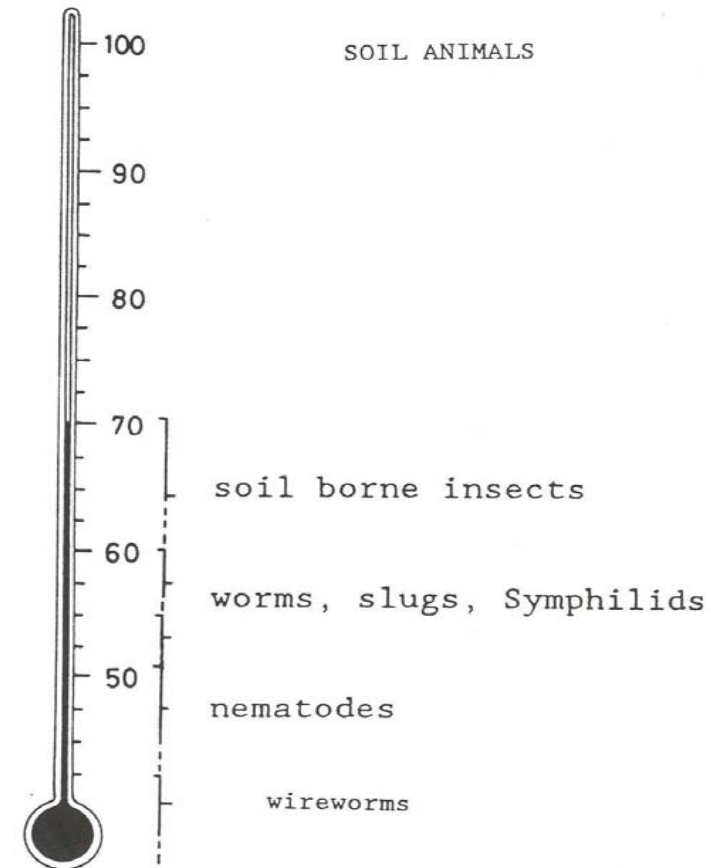
- **Nemathodes**
- **Bacteria**
- **Fungi**
- **Weeds**

Lethal temperature

LETHAL TEMPERATURES OF PLANT PATHOGENIC MICRO-ORGANISMS
IN SOIL - EXPOSURE TIME 30 MINUTES



LETHAL TEMPERATURES OF SOIL ORGANISMS
EXPOSURE TIME 30 MINUTES



Example steaming South Africa

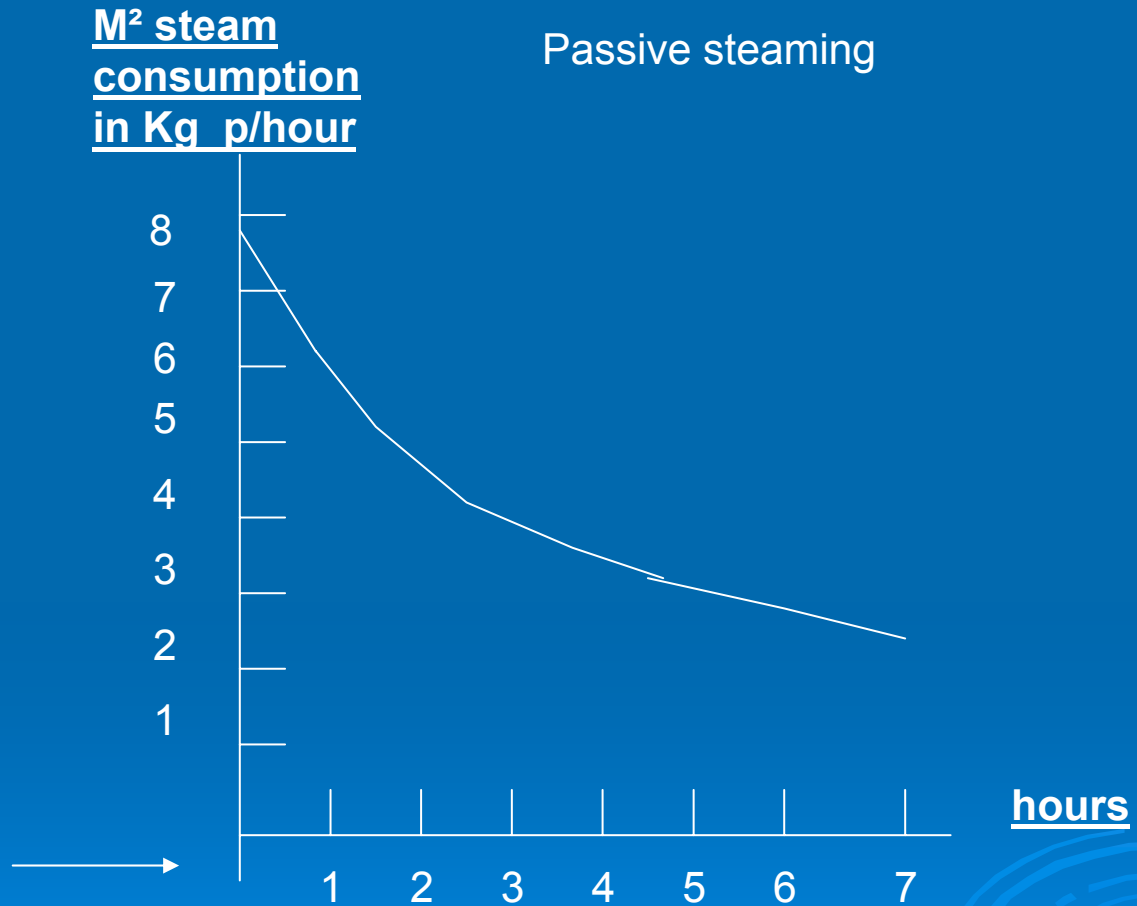


Why steam application technically

1. Best energy carrier.
2. 1 Kcal/liter water for 1° C up to 100° C
3. From 100° C to steam 535 Kcal/ liter.
4. At 160° C only 0,5 Kcal/1 kg
5. Easy to handle

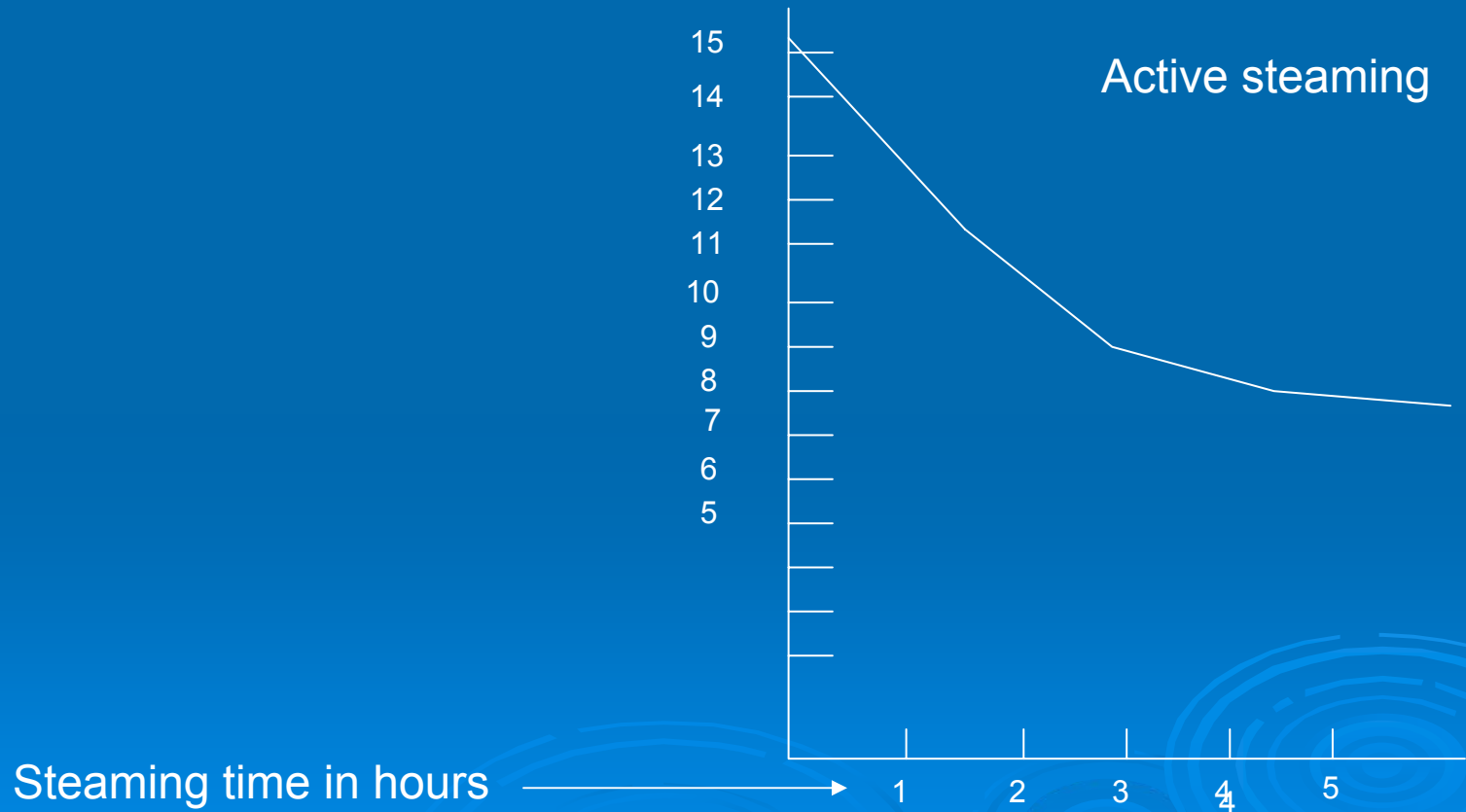


Sheet steaming



Negative pressure

steam consumption in kg / h / m²



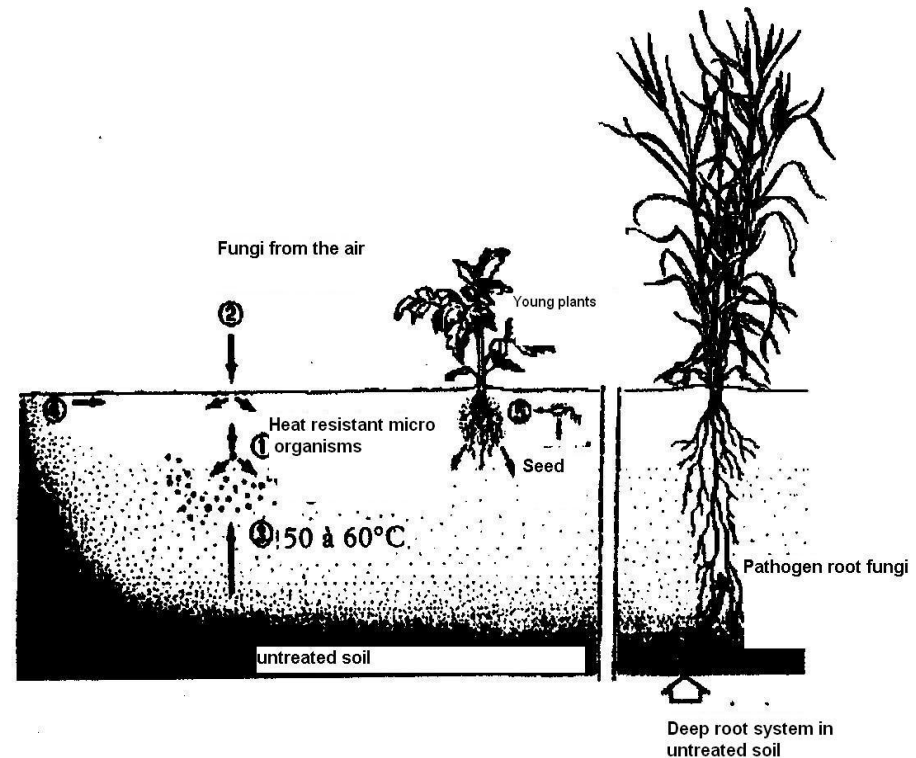
Soil preparation before steaming

1. For good results
2. Rotary spading machine
3. Humidity



Soil after steaming

1. Micro flora soon returns
2. Nourishment and first colonists
3. Next group from underground
4. Deeply rooted plants
5. Carbon sources
6. Bacteria
7. Steam mildew's
8. Ammonium level
9. Laboratory results



Origin of pioneers microflora

Different steaming methods

1. **Sheet steaming**
2. **Hoods** „ „
3. **Bunker** „ „
4. **Spading / steaming machine**
5. **Negative pressure steaming**







Bunker steaming



Application



Negative pressure steaming

1. Explanation of system
2. Comparison of results
 - clay soil
 - loam soil
 - peat soil
 - sandy soil



Example calculations

- A boiler has a capacity of 2000 kg steam per hour

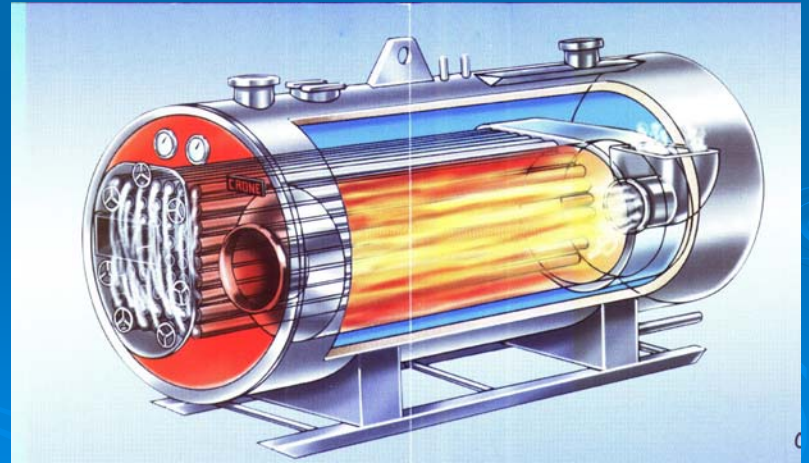
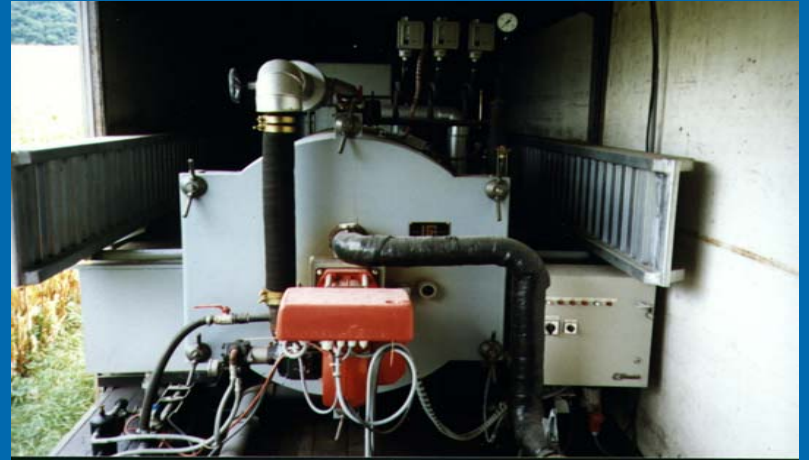
PASSIVE STEAMING

1. - Steam usage at the start is ± 10 kg steam/hour m^2
 - Maximum production at the start is $2000 : 10 = 200 m^2$

2. ACTIVE STEAMING (negative pressure)

- Steam usage at the start is 15 kg steam per / hour m^2
 - Maximum production at the start is $2000 : 15 = 133 m^2$
 - When active steaming the steam penetrates in the almost twice as fast (see graphics)
3. The steam usage gradually decreases in the run of time, caused by condensation of steam in the soil. (see graphics)
4. The boiler capacity in 8 hours is $8 \times 2000 = 16000$ kg production in 8 hours at $70^\circ C$ is $16000 : 30 = 530 m^2$
production in 8 hours at $90^\circ C$ is $16000 : 40 = 400 m^2$

Boilers



Safety and discipline

Steam can be dangerous

- 1. Before start check boiler on :
 - temperature – pressure – water level
 - never beyond maximum settings**
- 2. Check every connection of pipes**
- 3. Sheets should be fastened properly**
- 4. Trousers in boots and wear gloves**
- 5. Never walk from untreated to treated soil**
- 6. Whenever the anchored sheet edges become disconnected first close the valve at all times before you go between the sheets**

Thank you for your attention

Author Marten Barel

International Consultant.

Specialist in alternative for soil disinfestations

E-mail marten.barel@iae.nl

Tel. +31(0)40-2532726