



Training in organic breeding

Module 15: **Hot Water Treatments for Seed Health**

Unit 15.2: **Contamination thresholds and
detection**

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Location of pathogens in seed

- Biotrophs

- Obligate parasite, do not kill the host, have narrow host range, can not be cultured; viruses some fungi; typically in embryo

- Necrotrophs

- Kill host cells, feed on dead tissue, wide host range, can be cultured; fungi and some bacteria; typically seed coat and/or endosperm

Pathogens on the seed coat

- *Xanthomonas campestris* pv. *campestris* - black rot in crucifers
- *Pseudomonas syringae* pv. *tomato* - bacterial speck in tomatoes
- *Alternaria* spp.- causes blights
- *Cladosporium* spp. - causing leaf mold
- *Botrytis cinerea* - causes gray mold
- Tobacco mosaic virus (TMV)

Pathogens on the seed coat

- *Fusarium spp.* – causing wilt and root rot
- *Verticillium spp.* – Verticilium wilt
- *Colletotrichum spp.* - causing anthracnose
- Tomato Brown Rugose Fruit Virus (ToBRFV)

Pathogens in the edosperm

- *Fusarium spp.* – causing wilt and root rot
- *Aspergillus spp.*
- *Penicillium spp.*

Pathogens in the embryo

- *Fusarium spp.*
- *Colletotrichum spp.*
- *Pseudomonas syringae pv. phaseolicola* - causes halo blight in beans
- *Xanthomonas campestris pv. vesicatoria* - causes bacterial spot in peppers and tomatoes
- Tomato Mosaic Virus (ToMV)
- Tobacco Mosaic Virus (TMV)

Seedborne inoculum thresholds

- Lettuce mosaic virus (LMV)
 - zero tolerance in USA and Australia
 - 0,1% in Europe
- *Xanthomonas campestris* pv. *campestris* in brassicas
 - 1 in 30 000 seeds
- *Phoma lingam* in brassicas
 - 1 in 10 000 seeds
- *Ascochyta fabae* in broad beans
 - 1 in 600 seeds
- *Cylindrocladium parasiticum* in peanuts
 - 1 in 400 seeds

Seed health testing

- **Sensitive** – able to detect pathogen at low concentration
- **Specific** – able to detect targeted pathogen in the presence of non-targets
- **Speed** – rapid turnaround
- **Reliable** – unaffected by slight variation in test conditions
- **Repeatable** – consistent performance
- **Reproducible** – transferable, consistent performance across different laboratories
- **Cost-effective**

Methods of detection of seed borne pathogens

Test type	Fungi	Bacteria	Virus	Nematodes
Visual examination	√	x	x	x
Grow-out	x	√	√	x
Bioassay	x	x	√	x
Wash or Soak - microscope exam	√	x	x	√
Blotter test	√	x	x	x
Agar media test	√	√	x	x
ELISA	x	√	√	x
PCR	√	√	√	√

Blotter Tests

- For fungal pathogens
- **Advantages** - inexpensive, versatile, direct observation of viable pathogen
- **Limitations** – small numbers of seeds is tested, expertise needed



Seed Health Methods 2023 (Desktop Version)

Price

Free

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•  7 001a Detection of <i>Alternaria dauci</i> in <i>Daucus carota</i> (carrot) seed by blotter method	Download
•  7 001b Detection of <i>Alternaria dauci</i> in <i>Daucus carota</i> (carrot) seed by malt agar method	Download
•  7 002a Detection of <i>Alternaria radicina</i> in <i>Daucus carota</i> (carrot) seed by blotter method	Download
•  7 002b Detection of <i>Alternaria radicina</i> in <i>Daucus carota</i> (carrot) seed by malt agar method	Download
•  7 003 Detection of <i>Botrytis cinerea</i> in <i>Helianthus annuus</i> (sunflower) seed	Download
•  7 004 Detection of <i>Leptosphaeria maculans</i> and <i>Plenodomus biglobosus</i> in <i>Brassica</i> spp seed	Download
•  7 005 Detection of <i>Ascochyta pisi</i> on <i>Pisum sativum</i> (pea) seed	Download
•  7 006 Detection of <i>Colletotrichum lindemuthianum</i> in <i>Phaseolus vulgaris</i> (bean) seed	Download
•  7 007 Detection of <i>Alternaria linicola</i> <i>Botrytis cinerea</i> and <i>Colletotrichum lini</i> in <i>Linum usitatissimum</i> (flax linseed) seed	Download
•  7 008 Detection of <i>Caloscypha fulgens</i> in <i>Picea engelmannii</i> and <i>P. glauca</i> (spruce) seed	Download
•  7 009 Detection of <i>Fusarium circinatum</i> in <i>Pinus</i> spp (pine) and <i>Pseudotsuga menziesii</i> (Douglas fir) seed	Download

To summarize:

- Pathogens can be **located** in the seed coat, endosperm, or embryo, and this determines both risk and treatment options
- **International and national thresholds** for seedborne inoculum vary by pathogen and reflect their epidemiological importance
- **Effective seed health testing** must be sensitive, specific, reliable, and cost-effective.
- **Methods** such as blotter tests, agar plate methods, and molecular assays are commonly used, with ISTA protocols providing standardized procedures
- **Reliable detection and threshold-based decision**-making are essential prerequisites for deciding whether hot water treatment or other measures should be applied

In the next unit, we will turn to the process of hot water treatment itself, looking first at general considerations and workflow.



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