Maximizing seed health in your seed saving practices

Anna Testen and Sally Miller
Department of Plant Pathology
What will you learn today?

• How do seedborne diseases spread?: A case study with quinoa
• Plant pathology basics
• Important seedborne diseases of vegetables
• Seed treatments to prevent seedborne disease spread
• Hands-on seed treatment demo
Plant Pathology Forensics: A Quinoa Case Study
Quinoa Downy Mildew
Quinoa is native to the Andean Region of South America

• But quinoa downy mildew has been reported in Canada, Britain, Egypt, Morocco, South Korea, Turkey, Denmark, India, and etc.

• How does this disease spread???
How was \textit{P. variabilis} introduced to the United States?
Did seedborne oospores serve as inoculum?
Is *P. variabilis* detectable in quinoa seeds?

- 25 of 32 lots tested positive based on sequence analysis
- 23 of 32 lots tested positive with PCR based detection method
- 15 of 16 quinoa seed lots purchased in State College, PA tested positive
What Causes Disease in Plants?

- Fungi
- Oomycetes
- Bacteria
- Viruses
- Viroids
- Nematodes
- Parasitic Plants
Fungi That Attack Plants

- Fungi (molds) are microscopic plant-like organisms
- Most fungi are NOT plant pathogens
- Grow vegetatively by production of long filaments called hyphae
- Most produce spores
- Many also produce specialized structures (pycnidia, ascocarps, sclerotia, etc.) for reproduction and/or survival

Spores of *Alternaria* (early blight)

David Malloch, Univ. Toronto
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Pycnidium and spores of Septoria
Oomycetes That Attack Plants

- “Fungal-like” organisms related to diatoms and brown algae
- Reproduce in water ("water molds")
  - Produce swimming spores ("zoospores")
- Produce specialized structures for long-term survival (oospores)
Bacteria That Attack Plants

- Tiny (<5 µm) single cells (much smaller than fungi and oomycetes)
- Most bacteria are not pathogens
- Cause spots, blights, wilts and soft rots

http://www.cellsalive.com/cells/3dcell.htm
Viruses & Viroids That Attack Plants

- Viruses are particles consisting of protein plus RNA or DNA
- Viroids are RNA particles
- Moved from plant to plant by insects - “insect transmission”
- Others moved around in plant sap - “sap transmitted”
Nematodes That Attack Plants

- Small, wormlike organisms
- Most are not plant pathogens
- Plant pathogenic nematodes have a needle-like stylet to withdraw nutrients from plants
- Have multiple life stages
- All species lay eggs

[Image of Helicotylenchus nematode with labeled stylet]
Plant disease triangle

Plant

Pathogen

Environment
How to Minimize Plant Disease

• **Plant**
  – Use genetically resistant plants
  – Reduce plant stress; grow robust plants
    – Provide balanced water and nutrition; appropriate light

• **Environment**
  – Manipulate environment to favor plant, not pathogen
    • Moisture management; temperature
    • Protected culture!

• **Pathogen**
  – Avoid pathogen build-up
    • Sanitation, crop rotation, exclusion
Seedborne Diseases - Vegetables

• Not all groups of pathogens or pathogens within a group are seedborne
• Problems vary by crop
• Most common seedborne pathogens of vegetables:
  – Bacteria
  – Viruses
  – Fungi
SOME EXAMPLES OF COMMON SEEDBORNE DISEASES OF VEGETABLES
Septoria Leaf Spot or Blight

- Favored by rainy conditions
- Spots appear on leaves and stems at any stage of plant growth
- Tiny, dark fruiting bodies in lesions
- Plants may lose leaves
- No fruit symptoms
- Also on celery, lettuce, parsley, celeriac
Anthracnose - *Colletotrichum*

- Favored by warm, wet weather
- Symptoms mainly on fruit
- Symptoms may occur on both ripe and green fruit
Seedborne Diseases Caused by Bacteria

- Favored by rainy, humid conditions
  - Temperature optima vary
- Localized or systemic in plants
  - Localized bacteria – external on seed
  - Systemic bacteria – internal in seed
- Affect all above-ground plant parts
  - Systemic bacteria also in roots
  - Fruit infections lead to seed infection/infestation
Bacterial Spot
Bacterial Canker

Bacterial Speck
Black Rot of Cruciferae
Cucurbit Angular Leaf Spot - *Pseudomonas*
Cucurbit Bacterial Spot - *Xanthomonas*
Seedborne Viruses: Tobacco Mosaic Virus (TMV)

- Affects foliage and fruits
  - Mosaic, leaf distortion, stunting
- Virus very stable – survives a long time (years)
- Mechanically transmitted
- External seed infestation
Bulb-borne diseases

- Major issue in garlic
- Several pathogens are problematic

White rot (fungal disease)

Bloat nematode

Viruses
AVOID COLLECTING SEED FROM DISEASED PLANTS!!

What do sick plants look like?
Minimizing Seedborne Diseases

• Keep plants healthy
• Scout crop routinely
• If a disease appears, get a diagnosis
  – OSU Vegetable Pathology Lab
  – County Extension office
• Rogue out diseased plants early
• May need fungicide treatments
• Treat seeds with a sanitizing treatment
Seed Treatments

• Clorox treatment very effective for external infestations of any pathogen type
  – Clorox treatment: 25 oz clorox:100 oz water + 1 tsp surfactant for 1 minute, followed by 5 minutes rinse in running tap water
  – Kills bacteria, viruses and fungi on seed surface
  – May not kill internal pathogens

• If organic, check with certifier for chlorine use
Seed Treatment with Hot Water

• Kills internal and external plant pathogenic bacteria
  – Does not kill plant pathogenic viruses or fungi
  – Does not kill human pathogens

• Allowed in organic systems

• We now recommend following hot water treatment with Clorox treatment if feasible
Water Bath Temperatures and Treatment Times

<table>
<thead>
<tr>
<th>Seed</th>
<th>°F</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brussels sprouts, eggplant, spinach, cabbage, tomato</td>
<td>122</td>
<td>25</td>
</tr>
<tr>
<td>Broccoli, cauliflower, cucumber*, carrot, collard, kale, kohlrabi, rutabaga, turnip</td>
<td>122</td>
<td>20</td>
</tr>
<tr>
<td>Mustard, cress, radish</td>
<td>122</td>
<td>15</td>
</tr>
<tr>
<td>Pepper</td>
<td>125</td>
<td>30</td>
</tr>
<tr>
<td>Lettuce, celery, celeriac</td>
<td>118</td>
<td>30</td>
</tr>
</tbody>
</table>

* Cucurbit seeds may be damaged by hot water treatment
We are in the process of updating this factsheet

Will be posted on u.osu.edu/vegetablediseasefacts/
Dry heat treatment

- Still experimental
- Effective against viruses, fungi, and bacteria
- Watch for more information, no factsheets currently available
HCl treatment of tomato seeds

• Effective against seedborne viruses and bacterial diseases

Directions (from Dr. Melanie Ivey, OSU)
1. Prepare a 5% solution of HCl by adding one part acid to 19 parts potable water. Prepare the acid solution in a well ventilated area and avoid direct skin contact with the acid.
2. Soak seeds for 6 hours with gentle agitation.
3. Carefully drain the acid off of the seed and rinse seed under running potable water for 30 minutes. Alternatively, rinse the seeds 10-12 times with potable water to remove residual acid.
4. Spread seeds evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides, or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

TSP treatment of tomato seeds

• Used to eradicate seedborne TMV

Directions (From Dr. Melanie Ivey, OSU)

1. Prepare a 10% solution of TSP (1 part TSP in 9 parts potable water). Trisodium phosphate is available at most home supply or paint stores. Avoid direct skin contact with the TSP solution.
2. Soak seed for 15 minutes in the disinfectant solution.
3. Rinse the seed in a cold water bath for 5 minutes to remove residual disinfectant.
4. Spread seeds evenly on clean paper towel or a sanitized drying screen to dry. Do not dry seed in area where fungicides, pesticides, or other chemicals are located.
5. Seed can be treated with a labeled fungicide to protect against damping-off pathogens.

How to Test Seed Germination

• Mix seeds in each seed lot and count out 50 seeds per seed lot

• Hot water- or Clorox-treat 1/2 of the seeds exactly as described

• After treated seeds have dried, plant the two groups of seeds separately in flats containing planting mix

• Allow the seeds to germinate and grow until the first true leaf appears
Testing Seed Germination......

• Count seedlings in each group separately

• Determine the % germination in each group

\[
\frac{\text{# seedlings emerged}}{\text{# seeds planted}} \times 100
\]

• Compare % germination in each group
  – should be within 5% of each other
Seed Treatment Cautions

• Use new, high quality seed

• Treat a small sample first and test for germination

• Treat close to time of planting or distribution (within weeks)

• Treat only once
For More Information on Vegetable Diseases and Management

• Ohio Veggie Disease News
  – u.osu.edu/miller.769

• Vegetable Disease Facts
  – u.osu.edu/vegetablediseasefacts/

• VegNet Newsletter
  – u.osu.edu/vegnetnews

• Twitter
  – @OhioVeggieDoc